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A TEXT-BOOK

OF

ELECTRO-THERAPEUTICS

AND

ELECTRO-SURGERY,

FOR THE USE OF STUDENTS AND GENERAL PRACTITIONERS.

BY

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TO

WILLIAM TOD HELMUTH, M.D.,

PROFESSOR OF SURGERY, NEW YORK HOMŒOPATHIC COLLEGE, AS A TOKEN OF APPRECIATION OF HIS HIGH PROFESSIONAL ATTAINMENTS, AND AS A MARK OF PERSONAL ESTEEM AND FRIENDSHIP, THIS WORK IS DEDICATED.

THE AUTHOR.

PREFACE.

THIS work is not by any means intended to be an exhaustive treatise, but is written to endeavor to place electricity in its proper light before the student and general practitioner, from a homœopathic standpoint, and in as condensed a form as possible. I have purposely omitted all uncertainties and dealt only with facts. For the purpose of ready reference, I have divided the work into seven parts. The first part is devoted more particularly to the symptoms produced on the healthy organism by the different forms of electric current. The second part, to therapeutical indications for their use, illustrated by suitable cases, selected as far as possible from the works of others, preferring to prove the homœopathic relation of electricity to disease, from the lips of other witnesses, rather than by a report of my own cases. As the cases quoted were recorded before the theory laid down in this work was written, it is impossible that they could have been trimmed to suit it. The third part gives general directions for conducting ordinary electrical treatment, and a description for the more common forms of electrodes.

The indications for the use of electricity in obstetrics take up the fourth part. Electro-diagnosis the fifth. In part six is discussed the various uses of the electric current in surgery, illustrated by my own cases (having here no new theory to support).

Part seven is a mere outline of the principal points of electro-physics, the author considering it quite unnecessary to dwell on this subject, there being already so many excellent treatises upon it.

Mention of the use of statical magneto-electricity has been purposely omitted, as no positive or reliable experiments have yet been made with it. The machines are moreover unreliable and troublesome, and do not admit of being so readily graduated in strength as the galvanic and electro-magnetic currents.

My thanks are due to Drs. H. C. Houghton, of this city, Wm. N. Tooker, of Chicago, and E. Murphy, of New Orleans, who have kindly furnished me with the reports of cases and other data. I would also acknowledge the kindness of Mr. Bartlett, of the Galvano-Faradic Company, Mr. Clelland, of the Western Electric Manufacturing Company, and Messrs. Flemming & Talbot, of Philadelphia, who have lent me some of the wood-cuts of their instruments.

JOHN BUTLER, M.D.,
25 East Thirty-first Street, N. Y.

May 23d, 1878.

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ELECTRO-THERAPEUTICS AND ELECTRO-SURGERY.

PART I.

THE POSITION ELECTRICITY SHOULD OCCUPY IN THE MATERIA MEDICA.

CHAPTER I.

FROM the time of Kratzenstein, down to the present day electricity in one form or another has been used in the treatment of disease. At one time taken up by the so-called "Regulars" as a panacea for all the ills that flesh is heir to; at another condemned and consigned to oblivion, to be again resurrected and resuscitated by some aspiring charlatan, who boasts exultingly of the marvellous cures he has made and can make through its agency. That empirically numbers of cases abandoned as hopeless have been restored to health, both by the quacks of years gone by and those of the present day, is an indisputable fact; but what percentage of all the cases treated were benefited we know not, neither do we know how many were injured by their great cure-all. Such men's experience, if indeed it can with any degree of propriety be called such, has been but of little value to the profession, except so far as it has stimulated others to investigate for themselves and for the profession.

To the scientific physician, who would be an accurate prescriber and a sound pathologist, there is perhaps nothing so utterly distasteful as empiricism. Yet one cannot take up any work on electro-therapeutics of the allopathic school (and it is a matter of regret that almost all, if not quite all, of our literature on the subject emanates from that body), without being struck with the

amount of quackery and guesswork on which their *theories* are based. Chapter upon chapter is devoted to so-called electro-physiology, which enters into the minutest detail of the action of electricity upon every tissue in the human frame, without its being put to any use whatever in their chapters on the treatment of disease. After perusing any and all of such works the reader is in a greater state of confusion, and knows absolutely as little of the practical value of the electrical current at the bedside and in the consulting room as he did before reading them.* If we take, for example, the latest work on the subject, *Electricity in Medicine and Surgery*, by G. V. Poore, M.D., which perhaps is without exception the best work that has been ever written on it, we find that the sum total of all this author's experience and research is, that electricity is a *stimulant, anodyne, sedative, caustic, styptic*, or *cautery*. In other words, that it may be used as a substitute for *Alcohol, Opium, Bromide of potash, Nitrate of silver, Persulphate of iron, or the last-mentioned metal at a high temperature*. Now if that is all that electricity is we certainly can do as well without its use as with it. But, as I hope to show further on, electricity is a force, which on being transmitted through any tissue in the human body, produces a certain train of symptoms, and is capable of curing just such symptoms when they occur idiopathically. Before entering upon the details of our subject, it is perhaps advisable here to consider the various modes of generating the electric current, etc. In any text-book on electro-physics we find that electricity is divided into three forms:

1. Static or Frictional.
2. Galvanic or Contact.
3. Induced or Faradic.†

To which I would add Animal Electricity, as generated by the electric eel, Natural Electricity, or that generated during thunder-storms, etc. I call it natural advisedly (for the want of a better term), to distinguish it from that artificially generated by apparatus

* Of course I am not now alluding to the chemical action of the current, so useful in electro-surgery, upon which subject we have many excellent works.

† There are also other varieties, as Thermo-electricity, etc.

for the purpose. But however generated, it is the same force, is governed by the same laws, and yields to the same tests. These divisions only allude to its method of generation, which necessarily influence it in quantity, tension, etc., but do not change its identity. This *vis naturæ* is still a unit, wherever found or in whatever garb it may be clothed, though it may be influenced as far as quantity and intensity are concerned by its mode of generation, by the resistance through which it is transmitted, by duration, interruption, reversion of direction, etc., but the force remains the same, whether the current is called galvanic, faradic, or static. It is the same subtle power that destroys man and beast, and tears up trees by the roots, that relieves the pain of, and lulls to sleep, a sensitive child; just as the warmth of fire will call back into life half-famished nature, or totally annihilate and destroy it, according to the intensity with which it is used, or the control which we have over it. So with any of our remedies.

Writing these lines calls forcibly to mind a passage from one of the greatest of poets, Schiller, which is quite as applicable to the force of electricity as to the energy of fire.

"Wohlthätig ist des Feuers Macht
Wenn sie der Mensch bezähmt, bewacht,
Und was er bildet, was er schafft,
Das dankt er dieser Himmelskraft.
Doch furchtbar wird die Himmelskraft
Wenn sie der Fessel sich entrafft,
Einhertritt auf der eignen Spur
Die freie Tochter der Natur.
Wehe, wenn sie losgelassen
Wachsend ohne Widerstand
Durch die volkbelebten Gassen
Wälzt den ungeheuren Brand!"

* * *

It is so difficult to investigate all the facts of galvanism in anything like progressive order, that it seems best to first examine the sources of the force and the laws which govern it, assuming for the present that the reader possesses a knowledge of the principles necessary to an understanding of the facts, and afterwards, when we come to consider electro-physics, to go over this ground

again thoroughly and in detail, though feeling that in so doing we may be telling the reader much that he may be familiar with.

If we partially immerse a sheet of zinc in a mixture of ordinary sulphuric acid and water, we find that as the zinc is dissolved bubbles of hydrogen are formed and the liquid becomes heated.

If we vary the experiment by placing in the same liquid with the zinc a sheet of copper, we see that the bubbles of gas still rise to the surface from the zinc, while none come from the copper. Should the metals touch, however, the bubbles rise in large quantities from the copper, though none of the copper is dissolved, as can be easily ascertained by chemical tests. If we connect the immersed metallic plates by wires above the liquid, we discover that this wire becomes immediately capable of influencing the mariner's compass, so that it no longer points to the north and south; of magnetizing iron and steel; and if the wire be severed, and the ends dipped into a liquid, the liquid undergoes chemical decomposition. Now what does all this? The energy that is eliminated during chemical decomposition, in other words the galvanic current, and the copper and zinc plates immersed in the dilute acid, is the simplest and most primitive form of galvanic battery, and though defective for all uses in electro-therapy, will answer the purpose of describing the generation of galvanism better than perhaps any other. To sum up, the result of the immersion of a plate of zinc and a plate of copper (connected by a wire) in a vessel of dilute sulphuric acid is, the water HO_2 is decomposed, and gives off its hydrogen. The zinc is dissolved and unites with the oxygen of the water, forming ZnO, which oxide is redissolved by the acid, and the resultant salt is $ZnSO_4$; at the same time energy or the galvanic current is set free. The zinc plate, or the *metal acted* upon, is called the positive plate, and the copper, or the *metal not* acted upon, is the *negative plate.* The wire connected with the negative plate is called the positive pole, because the current *positively* flows from that direction, and the wire from the positive plate is called the negative pole. These technical terms, about which there has been much confusion, are, therefore, not arbitrary terms, and will be again entered into more fully. Now if we want a more intense current (that is, a current

capable of overcoming a greater amount of resistance)* than is generated in a single cell, we unite a series of these cells; the positive wire of one cell being connected with the negative of the next, and so on to the end of the series, leaving a negative wire at one end of the circuit and a positive at the other free, to be used to transmit the current through any object we may wish to act upon.

But if we wish to generate a larger quantity of current than one cell is capable of doing, we connect the poles positive to positive and negative to negative. However, this kind of battery is not necessary in electro-therapy;† at least is only employed to heat wire, etc., in galvano-cautery operations. It is alluded to for the purpose of avoiding any misunderstanding with regard to the terms quantity and intensity. If we wish to reduce the quantity of current passing through any body, it is only necessary to introduce into the metallic part of the circuit a resistance or series of resistances. Brenner's rheostat answers this purpose admirably, and by its means we can control the amount of actual current we wish to use.

The effect of the current in magnetizing iron or steel has been cursorily spoken of. If the wires joining the poles of the battery be coiled around a bar of iron the bar becomes magnetized. If the bar be made of soft iron, it remains a magnet only so long as the current flows. Should it be made of *steel*, however, it becomes permanently magnetized, or remains a magnet until demagnetized by some other means. But there is another effect. The current in its passage becomes highly intensified, though reduced in quantity in the direct ratio of the thickness of the wire composing the coil, and in the inverse ratio of its length. Otherwise expressed, the shorter and thicker the wire, the larger the quantity and less the intensity. The longer and finer, the less the quantity and the greater the intensity. Now suppose, over any given coil of this kind, we wind a coil of finer wire, but perfectly insulated from the first coil, we have a current induced in it infinitely more intense, and infinitely less in quantity, and flow-

* The resistance of the human body is very great; from hand to hand in a man of ordinary height is equal to 750 miles of telegraph wire.

† The resistance of the body is so great that it is incapable of transmitting but a very small quantity of electricity.

ing in the opposite direction to that in the primary wire, and should we still add coil over coil, we may dynamize, and at the same time potentialize our current *ad infinitum*. This current can, however, only be felt at the opening and closing of the circuit. For the discovery of these facts we are indebted to Faraday, and this manner of using electricity is called faradism, in honor of the discoverer. It is also called electro-magnetism.* Now what does electro-magnetism mean? A mixture of electricity and magnetism? Surely it cannot mean that, for the bar of soft iron, before it was influenced by the action of the current transmitted through the coil surrounding it, was nothing but a bar of soft iron, and, after the current discontinues to flow, is nothing but a bar of soft iron still. It is, therefore, evident that it is the same current increased in intensity and diminished in quantity by this process that still exists. Nor does it require a very great stretch of the imagination to compare the galvanic current used as it flows from the cells to our crude drugs and mother tinctures. When influenced so that its quantity is reduced by resistances placed in the circuit, to our low dilutions, and when intensified and reduced in quantity by induction, to our higher attenuations. If, added to this, we take into consideration that many symptoms produced by one form of current are capable of being cured when they occur idiopathically, by the other form, the analogy is still more striking. A consideration of statical or frictional electricity is purposely omitted, as the use of it in therapeutics is impracticable.

In my first researches in electro-therapeutics I could not help noticing how frequently symptoms were aggravated by the action of the current, which it was my design to ameliorate, and in which electrization was seemingly indicated (that is, reasoning as allopathists do, because it had cured other diseases of the same kind); I therefore determined to study systematically the symptoms that electricity produced on the healthy organism, and find out with some degree of precision at least whether the same symptoms

* I would prefer the term "induced electricity," but, as it is already better known under the name faradic current, I have here continued the use of the latter name.

were not curable when occurring in diseased conditions. First, having compiled a list of positive symptoms from works on electro-physiology, giving the preference to those which had been repeatedly verified, I began to prescribe electricity for such symptoms when I noticed them in diseased conditions, always using a much milder current (higher dilution) than the one that had produced the symptoms. The success of these experiments more than surprised me. It is, therefore, with no small degree of confidence that I offer to the profession the following pathogenesis of electricity, gathered and verified during many years by careful research and experience, and shorn of all unreliable and inconstant symptoms; and meagre though it be, and far from perfect, I hope it may be considered a first step in the right direction. Under the heading "Pathogenesis," the symptoms produced by the galvanic and faradic currents are given separately, together with the name or authority by which such effects were first recorded. Effects recorded by any one authority of reliability, though not repeatedly verified, that possibly might be of utility in practice, are marked by a ?, together with the authority's name attached. For all symptoms not so marked, and without any name attached, the author is responsible.

Under the heading "Symptomatology," the effects of every form of current are arranged under the subheadings of the organs affected. This method is adopted not only for the sake of precision, but as a ready mode of reference. For instance, if we refer to "chest" for the symptom, "heart's action retarded." By returning to pathogenesis we find how and where the current was applied that produced that symptom, and so on. It will, no doubt, be noticed that nothing is said about the strength of current to be used; but if the dose required of drugs taken by the mouth into the stomach is still in a state of uncertainty, is it anything to be wondered at that the "*dose*" of electricity necessary to be administered in any given case cannot, with any positive degree of accuracy, be always determined? at least no absolute rule for the guidance of the profession can be given, so on that account it was deemed best to omit a discussion of it altogether, leaving it an open question, to be discovered by individual experience, remembering it is always better to give too small a dose

than too large a one, and that the question of dose is not how much a patient will tolerate, but how little will cure. The repetition and duration of treatment I would also leave an open question; but, in the cases hereafter related, the notes generally contain a full account of these, from which we may glean a proximate idea as to how frequently it is necessary to repeat the *dose*, and also the length of seances ordinarily required.

CHAPTER II.

PATHOGENESIS.

CURRENT TRANSMITTED THROUGH HEAD AND CERVICAL SYMPATHETIC.

Galvanic current.	*Faradic.*
Dizziness. Vertigo. Dimness of sight. Feeling as if about to fall towards the side on which the anode is placed. Both eyes turn towards the cathode. At the moment of discontinuing the action, the reverse is observed and felt.—HITZIG.	Dazzling. Suffocation. Sharp piercing pain, especially when applied on forehead. Occasionally dizziness and same symptoms as galvanic current, with very sensitive patients. These symptoms are produced no matter in what direction the current be transmitted, but are most marked when a rheophore from each pole is placed in each auriculo-maxillary fossa.
After a prolonged galvanization of head, throbbing congestive headache, quickened pulse, and increase of temperature. Vertigo. Hæmorrhage. Convulsions.—NEFTEL.	
Insomnia.	
	The same rule applies to the galvanic current.
Applied to auriculo-maxillary fossa, vertigo with loss of equilibrium, nausea.—NEFTEL.	Muscular contractions in the parts supplied by the facial nerve. Lancinating pain through facial nerve and its ramifications.
Anæmia of brain.—HAMMOND.	
Dilatation of pupil.	
Phosphenes.	
Muscæ volitantes.	
Paleness of conjunctiva and tympanum.	
Protrusion of eyeball, and drowsiness during transmission of current.	
This condition after the removal of electrodes is soon followed by a throbbing headache, congestion of brain, quickened pulse, general excitement, and increase of temperature.	

Galvanic current.

Eyeballs suffused.

Ringing in ears.

Profuse perspiration in axilla.

Insomnia.

Budge says, galvanization of medulla oblongata produces relaxation of the heart, and makes it spread out?—*Archiv von Roser und Wunderlich*, 1846, *Band V.*

Vertigo. Hæmorrhage. Convulsions.—NEFTEL.

Vertigo, with loss of equilibrium and nausea, when current is applied in auriculo-maxillary fossa.—NEFTEL.

Faradic.

EYES.

Galvanization of that portion of the spinal cord lying between the seventh cervical and sixth dorsal vertebra produces dilatation of pupils.—WALLER AND BUDGE.

Direct galvanization of head in the neighborhood of the eye or of the cervical sympathetic produces dilatation of pupils.

Phosphenes.

Muscæ volitantes.

Anæmia of retina.—HAMMOND.

Paleness of conjunctiva.

Protrusion of eyeball, decrease of temperature, and drowsiness during transmission of current. After electrodes are removed, hyperæmia of conjunctiva.

Secretion and flow of tears and mucus. Sense of increased heat. Cathode produces a reddish-yellow light, anode a blue light.—PURKINJÉ.

Flashes at opening and closing of circuit. Cathode, objects appear more distinct; anode, less distinct.—HELMHOLTZ.

Duchenne records a case of amaurosis, accidentally produced by the galvanic current.—*Localized Electrization*, p. 17.

A current passed directly through the eye produces lancinating pain, copious secretion of tears, oval, vertical, or transverse dilatation of pupil, according as the current is transmitted horizontally or vertically. Pupil can be dilated or constricted according as the current is made to act upon the dilator or constrictor muscles of iris?—BEARD AND ROCKWELL.

EFFECTS OF CURRENT TRANSMITTED FROM EXTERNAL MEATUS OF ONE EAR TO ANOTHER.

Besides the symptoms just recorded, as caused by transmitting a current through the auriculo-maxillary fossæ, we find:

Galvanic current.

Burning pain. Noises like the bubbling of boiling oil.—VOLTA.

Vertigo.

Metallic taste on lateral and middle part of tongue, most marked on side of negative rheophore. Sensation of warmth. Increased secretion of ear-wax. First paleness of tympanum, afterwards hyperæsthesia and congestion of tympanum. Distinct musical sound at opening and closing of circuit.—RITTER.

Positive electrode in ear produces a sensation of pressure from without inwards; negative, from within outwards.—BRENNER.

Lower current intensities call forth murmurs. Higher musical sounds.—NEFTEL.

Cathode gives a higher musical sound than anode.—NEFTEL.

Torpor of nerve.—BRENNER.

Faradic.

Roaring, rushing noise, as if of wind.

Tickling, pricking sensation, followed by lancinating pain. Metallic taste on tongue.

Tinnitus aurium.

Hearing distance decreased, but whether this symptom was caused by the action of the current, or by the water introduced into the ears, could not accurately be determined.

ELECTRODES APPLIED TO SCHNEIDERIAN MEMBRANE.

Sensation as if about to sneeze, with inability to do so. Congestion. Copious secretion. Anosmia. Suppuration. Numbness of palate. Metallic taste. Congestion of eyes. Tears.

Titillation. Sensation as if about to sneeze. Profuse watery secretion, followed by a thicker secretion. Sense of stuffiness and fulness. Congestion of eyes. Tears.

ONE ELECTRODE PLACED IN MOUTH, THE OTHER ON NAPE OF NECK.

Peculiar metallic taste. Profuse secretion from all the salivary glands. Flashes of light. Toothache. Vitiation of taste. Loss of taste. Tongue feels paralyzed.

Metallic taste. Lancinating pains through teeth. Twitching of tongue. Numbness of tongue. Profuse salivation.

In addition to these, we have some of the symptoms before recorded under "*Head and Cervical Sympathetic Nerve.*"

PNEUMOGASTRIC NERVE.

Above Junction with Spinal Accessory.

BOTH CURRENTS.

Contraction of larynx, pharynx, and œsophagus.

Peripheral Galv. Inferior Laryngeal Branch.

Galvanic current.

Spasm of glottis. Retards heart's action to complete paralysis in diastole?—NEFTEL.

Contracts smooth muscular fibres of bronchi, diminishing their calibre; and contracts stomach, intestines, and uterus?—NEFTEL.

Faradic.

Indefinable præcordial sensation, with sense of suffocation. — DUCHENNE.

Spasmodic breathing and cough, Spasm of muscles of larynx and pharynx. Pain in chest and pit of stomach. Frequency of respiration increased. Syncope. Sugar in urine.—BERNARD, DUCHENNE, AND OTHERS.

Galv. of Cervical End.

Accelerates the inspiratory movements to tetanic inspiration. Increases production of sugar and salivary secretion. Diminishes pancreatic secretion, and retards heart's action. —NEFTEL.

Trunk of Nerve.

Coughing at cathodic closing and anodic opening. Less marked at duration.—KRIMER AND ROMBERG.

Upper Part.

Sugar in blood; in cerebro-spinal fluid. Secretion of urine suspended. Saliva increased. Respiration quickened.—BERNARD.

Frequency of pulse diminished.
Tetanic respiration.
Diaphragm contracted.

Lower Part.

Pulsation of heart ceased?—BERNARD, BROWN-SÉQUARD, AND OTHERS.

Tetanic respiration.

Diaphragm permanently contracted during transmission of current. — TRAUBE.

Nausea, vomiting, gastralgia.

SPLANCHNIC NERVES.

Galvanic current.	*Faradic.*
Pallor of surface and syncope.—NEFTEL. Peristaltic motions of intestines cease.—PFLUGER.	Same as galvanic, but not so constant, and in a less degree.

PHRENIC NERVES.

Inspiratory movements at cathodic closing and at anodic opening of circuit. Hiccough, sobbing, etc.	Tetanic respiration. Inspiratory movements at each interruption of circuit. Hiccough.

SPINAL CORD.

Convulsions at moment of closing circuit. Paralysis by continuous current.—MEYER. Pupil of eye enlarges when current is transmitted through upper part of dorsal spine.—WALLER AND BUDGE. Galvanism of lumbar portion of spinal cord produces contraction of the ducti deferentes, bladder, lower part of rectum, and uterus.	Rigid cramps of all the muscles of body.—MATTEUCCI. Muscles of trunk and extremities thrown into convulsions, which last some time after breaking the circuit.—MATTEUCCI. Pain in back. Exhaustion. Weariness.

CURRENT PASSED FROM MOUTH TO ANUS.

Gastralgia, with sinking feeling in stomach. Muscles convulsively contracted and fæces voided.—ALDINI. As the brain, sympathetic, pneumogastric, and spinal cord are more or less acted upon, and included in the circuit, we have many of these symptoms manifested before recorded under their proper headings.	Tetanization of sacro-spinal muscles, respiratory muscles, and muscles of extremities.—DUCHENNE. Should the current be sufficiently strong, complete opisthotonos; heart's action accelerated. Respiration increased in frequency.

URINARY ORGANS.

Bladder contracts at opening and closing of circuit, less so during transmission. Continues to contract after current ceases flowing. Contents expelled. Pain in abdomen followed by nausea. Pain along ureters and in region of kidneys. A profuse flow of urine generally follows the use of a current passed from lumbar region through bladder.	Bladder contracts violently and expels contents. Pain along ureters extending to kidneys. Horrible pain in hypogastric region.—DUCHENNE. Primary faradic current acts on bladder more powerfully than secondary. Continual desire to pass water.

SEXUAL ORGANS.

Galvanic current.

Vas deferens contracts. Testes drawn up. Scrotum rugated. Burning tearing pain through testes and cords. Penis becomes erect by transmitting a current from anus to glans penis. Pulsations in spermatic artery fuller. —TRIPIER.

Faradic.

The lancinating character of the pain so characteristic of this current is more marked in its effects upon the testicle than perhaps any other organ in the body. Spermatic cord contracts. Scrotum rugated. Acute pain as if the testes were being torn from the cords.—DUCHENNE.

UTERUS.

Contracts both during and after transmission of current. Contractions more violent if the current is passed through the length of the organ than transversely. Pain in lumbo-sacral region. Nausea and vomiting. Profuse flow of blood, lasting three or four days. Leucorrhœa at first watery and transparent, afterwards yellow, viscid, and flaky. Congestion, inflammation, and œdema of cervix.

Contracts violently during transmission of current.

Transient hyperæmia.—TRIPIER.

Cutting pain, which gradually changes to a severe bearing-down pain.—TRIPIER.

Profuse bloody discharge, both at the time of seance, and for two or three days following. Slight mucous leucorrhœa. Pain in hypogastric region. Nausea.

SKIN.

Burning sensation under both rheophores, most marked under negative. Increase of temperature, hyperæmia and hyperæsthesia. Herpetic and eczematous eruptions. Urticaria.—POORE, LINCOLN, AND OTHERS.

Congestion, erythematous patches.

Tingling. Elevation of papillæ. Acute darting lancinating pain under points of contact, most marked under negative electrode. Anæsthesia of skin between rheophores, more especially marked if the points of contact be close together. Congestion and redness of skin most marked under current of second helix.—DUCHENNE.

Itching coming on eight or ten hours after application. Acne of back and shoulders has followed several instances of faradization of spine, where before the current had been used the skin was perfectly healthly. Urticaria several cases.

NERVES, MOTOR AND SENSORY.

Galvanic current.

Strong current paralyzes nerve and renders it incapable of transmitting its contraction, producing stimulus.—VALENTINE.

Nerve paralyzed by constant current.—ECKHART.

Irritability of nerve decreased.

Contraction of muscles supplied by nerve at opening and closing of circuit; most marked under cathodic closing; less so under anodic opening. Pain burning, acute, as if molten metal was running through the nerve; most severe under the points where the rheophores were applied.

Faradic.

Pain tingling, acute, darting, lancinating. After electrodes are removed, the pain under the points where the electrodes were in contact still remains, sometimes producing great agony, with anæsthesia or partial anæsthesia between those points. Contraction of muscles supplied by nerve.

Duchenne in speaking of experiments with this current says: "These experiments are far from harmless, because in many cases the acute sensations have been followed by neuralgic pains in the organs overexcited."

MUSCLES.

Burning pain under rheophores. Tingling, as if the part were asleep. Contraction at opening and closing of circuit. Lame, tired feeling. Numbness and paralysis.

Sharp lancinating pain extending to surrounding textures, most severe under contact of rheophores. Contraction. Lameness and soreness of muscles. Paralysis.

The symptoms of general electrization, as produced either by the electric bath or by applying any form of electricity over every part of the body consecutively, only repeat, and in a confused manner, those already given; and such treatment used for the cure of disease amounts only to empiricism, confusion, and to a confession of ignorance of the pathology of the local lesion, and is too much like an allopathic bolus, or shooting into the bush to kill the bird, to have any place in the literature of a school of medicine which has the slightest pretensions to accuracy of prescribing.* And for these reasons I omit further allusion to it here, as a record of such a proving could only be of use for the sake of verifying the symptoms already recorded under their

* Of course I must not be understood to allude to the electro-chemical bath used for the purpose of eliminating poisons, such as lead, copper, etc., from the body, as I consider such baths eminently useful.

proper headings, which really are much more clearly verified under the following heading:

EFFECTS OF LIGHTNING.

Although not wishing to add thunder and lightning to our list of therapeutic remedies, or to treat disease by its agency, a word or two on its action may not be out of place here, for, as I have already shown, the force under consideration is the same, no matter what its mode of generation. That paralysis has been cured by lightning, also deafness, there is no doubt; for reports of cases cured I would refer the reader to Althaus's work on *Medical Electricity*, page 350; also *Thunder and Lightning*, by De Fonville, page 259. Leaving out its chemical effects, the symptoms recorded as having been produced by lightning are as follows:

Dizziness; loss of equilibrium; nausea; vomiting; insomnia; inability to prolonged mental study; loss of appetite; irritability; nervous prostration; muscular weakness; debility, nervous and muscular. Could not endure any amount of work without fatigue, though previously he would have scorned the idea of work having any effect on his nervous system.—B. W. MUNSON, M.D., Amityville.

Amaurosis. Deafness. Paralysis.—MUNSON. Micturition, diarrhœa.—MUNSON. Menstruation affected diversely; in some women menorrhagia, in others amenorrhœa.

Dr. Munson also records a case of paralysis of the leg, caused by a lightning stroke, cured by the faradic current.—*Archives of Electrology and Neurology*, vol. i, page 169.

CHAPTER III.

SYMPTOMATOLOGY.

SENSORIUM.

Inability to prolonged mental study.—MUNSON. Afraid he will suffocate. Sense of falling. Drowsiness. Loss of equilibrium. Nausea. Syncope. Nervous prostration.—MUNSON.

HEAD.

Dizziness. Vertigo. Dazzling. Pallor of countenance. Anæmia of brain. Hæmorrhage, convulsions. Throbbing headache, congestion of brain. Insomnia.

EYES.

Dilatation of pupil, phosphenes. Dizziness of sight. Muscæ volitantes. Paleness of conjunctiva. Protrusion of eyeball. Lancinating pain, copious secretion of tears. Oval, vertical, or transverse dilatation, according to direction of current. Anode causes a blue light to be seen; cathode, reddish-yellow. Anode, objects appear less distinct; cathode, more distinct. Anæmia of retina. Amaurosis. Halo of light often seen under influence of faradic current.

EARS.

Paleness of tympanum. Burning pain. Ringing in the ears. Roaring rushing noise as if of wind. Noises like the bubbling of boiling oil. Tickling pricking sensation, followed by lancinating pain. Congestion of tympanum. Increased secretion of ear-wax. Musical sounds. Pressure from within outwards or from without inwards, according to direction of current or polar influence. Torpor of nerve. Deafness?—MUNSON.

NOSE.

Sensation as if about to sneeze, with inability to do so. Congestion, inflammation, suppuration. Titillation. Profuse watery secretion, followed by a thicker discharge, with sense of stuffiness and fulness. Anosmia.

MOUTH, TONGUE, ETC.

Peculiar metallic taste. Profuse secretion from salivary glands. Toothache of a severe lancinating character. Twitching of tongue, numbness of tongue. Vitiation of taste, loss of taste. Tongue feels as if paralyzed. Sugar in salivary secretions.

THROAT.

Contraction of larynx, pharynx, and œsophagus. Spasm of

glottis. Spasm of pharyngeal and laryngeal muscles. Congestion, with afterwards profuse secretion of mucus. Visible pulsation of carotids.

STOMACH.

Pain over pit of stomach, nausea, vomiting. Indefinable sensation in region of stomach? Hiccough. Sinking feeling in pit of stomach.

ABOMEN.

Peristaltic action of intestines cease. Pancreatic secretion increased. Muscular coat of intestines contracted and fæces voided. Pain in hypogastric region. Diarrhœa?—MUNSON.

URINARY AND SEXUAL ORGANS.

Sugar in urine. Bladder contracts at opening and closing of circuit, less so during transmission. Pain in region of kidneys. Pain along ureters, extending to kidneys. Profuse flow of urine after galvanic current. Vas deferens contracts, testes drawn up. Scrotum rugated. Burning pain through testes and cord. Penis becomes erect by transmitting a current from anus to glans penis. Spermatic cord contracted. Acute pain, as if the testes were being torn from the cords.

FEMALE.

Uterus contracts, both during and after transmission of current. Pain in lumbo-sacral region. Transient hyperæmia. Profuse flow of blood, lasting three or four days. Leucorrhœa, at first watery and transparent, afterwards yellow, viscid, and flaky. Congestion. Inflammation and œdema of cervix. Amenorrhœa? Menorrhagia.—MUNSON. Cutting pain, gradually increasing to a severe bearing down.

NERVES, MOTOR AND SENSORY.

Strong current paralyzes nerve, and renders it incapable of transmitting its contraction, producing stimulus. Nerve paralyzed by constant current. Ascending current decreases irritability of nerve throughout its whole extent; descending affects only the part operated upon. Contraction of muscles supplied

by nerve at opening and closing of the circuit. Pain burning as if molten metal was running through the nerve, most severe under rheophores.—*Galv. current.* Pain, acute, darting, lancinating, under the rheophores, with anæsthesia or partial anæsthesia between the points of contact. Nervous debility.—MUNSON.

MUSCLES.

Burning pain.—*Galv.* Contraction at opening and closing of circuit. Lame, tired feeling, evolution of heat. Muscular debility. Numbness and paralysis. Lancinating pain.—*Farad.* Rigid cramps of all the muscles of body. Muscles of trunk and extremities thrown into convulsions, which continue for some time after breaking the circuit. Opisthotonos. Tetanus.

SKIN.

Burning sensation. Hyperæsthesia. Increase of temperature. Herpetic and eczematous eruptions. Urticaria.

Tingling, elevation of the papillæ, acute darting pain under points of contact with partial anæsthesia between these points. Congestion and redness of skin most marked under secondary induced current. Itching, coming on eight or ten hours after application. Acne of back and shoulders has in several cases followed faradization of spine.

CHEST.

Indefinable præcordial sensation, with sense of suffocation. Heart's action retarded. Smooth muscular fibres of bronchi contract. Inspiratory movements accelerated to tetanic inspiration. Spasmodic breathing and cough. Diaphragm permanently contracted during transmission of current. Constrictive pain all through region of chest. Frequency of respiration increased. Sobbing. Hiccough. Profuse perspiration in axilla. Rapidity of circulation increased.

BACK.

Tetanization of sacro-spinal muscles. Opisthotonos. Backache.

GENERALITIES.

Local anæmia, with subsequent hyperæmia. Vascular dilatation. Increase of perspiration. Elevation of temperature. Contraction of bloodvessels, with subsequent dilatation.—POORE.

Increased glandular secretion. Increased secretion of mucous membranes. General exhaustion and weariness.

PART II.

THERAPEUTICS.

CHAPTER IV.

Having established and admitted the truthfulness of the preceding chapters, the reader is forced to the following conclusions:

1st. That electricity is neither a panacea nor the contrary—a worthless remedy, but a polychrest of infinite value.

2d. That the symptoms produced by it are unique and peculiar—that is to say it has but few analogues in the *Materia Medica*, and there is no remedy or number of remedies that can completely fill its place, or be used as an efficient substitute for it.

3d. That on most of the organs affected by it, it shows two distinct* and separate sets of symptoms. One set occurring during the transmission of the current, and the other after the electrodes are removed, and continuing minutes, hours, or days, as the case may be.

4th. That these sets of *primary* and *secondary* symptoms are often the direct antipodes of each other, from a pathological standpoint, and correspond with the actions of our drug remedies.

As no proving can be considered complete, and entirely acceptable to the profession, without clinical verification, the following cases are recorded, collected mostly from Allopathic sources. The author refraining, as far as possible, from report-

* See especially Pathogenesis of Head and Cervical Sympathetic, page 20.

ing his own cases, preferring to prove the correctness of his theory from the experience of others.

These cases are given in the usual repertory order, commencing with diseases of the head, and ending with generalities:

HEAD AND CERVICAL SYMPATHETIC.

Cerebral Anæmia.

Almost every author extols galvanism as the remedy for this disease, although they all admit (as before mentioned) that it produces it. They try to get out of what seems to them to be a contradiction, by saying that the ascending current produces congestion, and the descending—anæmia. But this is emphatically not so; although I am ready to admit that descending galvanization of the cervical sympathetic produces more quickly anæmia of retina and brain, than ascending; the tension of the currents being the same. But whether we transmit the current in a direction ascending, descending, or transversely, anæmia is produced *primarily;* hyperæmia *secondarily.*

Hammond, in his treatise on Diseases of the Nervous System, honestly admits that it both produces and cures cerebral anæmia. At page 64, he says: "It may seem strange with the cases I have given, and with the knowledge from experiment and ophthalmoscopic examination, relative to the power of the primary galvanic current applied to the brain or sympathetic nerve, to contract the cerebral blood-vessels, that I should recommend the use of galvanism in cerebral anæmia. Clinical experience, however, shows that it is decidedly beneficial, provided the tension be very low. I am satisfied that not more than two or three cells should be brought into action in such cases, and that the current should not be passed for more than a few seconds at a time. It appears to give increased tone to the vessels, and promote the nutrition of the brain in a remarkable degree."

If we open any text-book on diseases of the nervous system, we find the symptoms given as belonging to cerebral anæmia, to be:

SENSORIUM.

Weakened power of mental perception.
Intellectual lassitude.

HEAD.

Vertigo. *Pallor of countenance.*
Tendency to syncope and convulsions.

EYES.

Pupils dilated and not sensitive to light.
Muscæ Volitantes.
Retina pale, also choroid.

EARS.

Ringing in the ears. Sensitiveness to noise.

GENERALITIES.

General muscular and nervous debility, with occasionally nausea and vomiting.

Now if we compare these symptoms with those produced by galvanism, page 20, we must admit that galvanism is the remedy most homœopathic to the condition, and that the symptoms of it are completely covered by this *one* remedy. The two following cases are illustrative:

Case I.—T. S., æt. 34. A salesman in a dry goods house, consulted me May 23d, 1874. Said he suffered from extreme *mental and physical prostration*, for several weeks, *was unable to concentrate his thoughts on any subject.* Easily annoyed by trifles. *Face pale, pupils dilated*, pulse compressible. Complained of *dizziness, vertigo*, and headache. Slept soundly, but was not refreshed by sleep. Extreme drowsiness after awaking in the morning, and at other times. Extreme weakness of the legs, which he says sometimes felt as if they would give way under him. Retina not examined. I galvanized cervical sympathetic with three, four and five Smee cells every day for a week, giving him five minute seances. After the third treatment the dizziness and headache disappeared, and at the end of the week he was so much improved, that I increased the inter-

val between the treatments, to once every three days, and at the end of three weeks dismissed him cured.

Case II.—L. B., æt. 42. Merchant, was sent to me for treatment by my friend, Dr. W. Tod Helmuth, Jan. 22d, 1877. He complained of mental exhaustion and depression, produced by brain fag, consequent upon large speculations in business which had not turned out favorably. He also complained of considerable pains in the legs and thighs (not sciatic), inability to walk any distance without great fatigue, though previously could walk a whole day without being tired. *No capacity or inclination for mental labor of any kind.* Trying to think gave him a severe headache, slept soundly, could go to sleep at any time of the day, *pupils dilated. Dizziness, paleness of face, general muscular and nervous debility.* Having faradized the muscles of the legs and thighs, with a view to removing the pains and lameness, I galvanized the cervical sympathetic (both sides) with a very weak current, for five or six minutes, using a Rheostat of several hundred ohms resistance. The improvement was immediate; on the 27th he expressed himself as feeling much better. I repeated the treatment on that day, and on February 3d, 17th, 24th, and on March 7th. On the latter date I dismissed him cured.

CHAPTER V.

Cerebral Hyperæmia.

The symptoms of cerebral hyperæmia are admirably covered homœopathically, as a general rule, by the secondary effects of galvanization of the head and cervical sympathetic.

The symptoms we most commonly meet with in this disease are:

HEAD.

Insomnia, or very light sleep, broken by frightful or disagreeable dreams. *Ideas confused*, forgets words or names of persons and things. Uses wrong words to express his ideas. Pronounces indistinctly. Illusions. Hallucinations. Irascible, impatient, peevish and fretful. *Severe throbbing headache*, with

a feeling of fulness in the head. *Vertigo. Vigor of mind diminished.*

EYES.

Muscæ Volitantes. Conjunctiva suffused. Intolerance of light. *Eyes painful. Retina hyperæmic.*

EARS.

Ringing in the ears, roaring in the ears. Intolerance of noise.

GENERALITIES.

Muscular paralysis, or paresis at various parts of the body. Twitching of muscles. *Loss of equilibrium. Loss of muscular power.*

The curative effects of galvanism in this disease are such, that in the allopathic school it is fast superceding every other mode of treatment.

Hammond says:* "The good effects of this treatment are well marked, a few applications being often sufficient to abolish the *vertigo and unpleasant feelings in the head*, and to restore mental and physical activity."

Case III.—Beard and Rockwell† report the subjoined case: "Mrs. H. was directed to us by Dr. H. Brayton Ball, to be treated for symptoms of cerebral congestion. Her general condition was much below par, and her menstruation, though regular, was painful, and prolonged from eight to ten days. Severe headaches were frequent, and for two years she had suffered from decided numbness of the whole left side, sufficient to prevent much labor or exercise. Faradization both general and local was essayed without good effect. Indeed, the numbness and vertigo were *decidedly*‡ *aggravated.* The second application, three days subsequently, was made with a current generated from four zinc-carbon cells. The positive pole was applied to the top of the head, and the negative immediately below the sternum. *A slight increase of numbness was observed* even from the weak current used, but in a few

* Diseases of the Nervous System, p. 51.

† A practical treatise on the medical and surgical uses of electricity.

‡ The italics are my own.

hours this effect passed away, leaving hardly a trace of the usual anæsthesia. This treatment was continued at intervals of several days, for over a month, during which time she was annoyed but little, if any, by either vertigo or numbness." In the work above alluded to, are recorded a number of other cases of cerebral hyperæmia, cured by galvanization of the head.* They are well worth studying.

The aggravation, such as produced in case III, is nothing unusual, and though by no means constant with such a mild current, is sufficiently alarming to show the need of great caution and skill in the administration of such a remedy. Occasionally even with a much milder† current than that used in this case, symptoms of severe aggravation are produced, which, though transient, and as far as my experience goes of no grave importance, are extremely disagreeable to the patient, and likely to shake his confidence in the physician who causes them, and, as they are quite unnecessary, should be avoided.

Grave's Disease, or Exophthalmic Goitre.

The most constant symptoms of this disease point out some form of electricity as the most suitable remedy. Almost all allopathic authorities are now agreed that the lesion causing the trouble exists in the sympathetic nerve, and hence prescribe galvanization of this part as the remedy, and with generally good results. That they are unconsciously homœopathizing, there is as little doubt as that they would indignantly deny it, if charged with it. The common symptoms of this affection are:

HEAD.

More or less *Insomnia*, or disturbed sleep. *Throbbing headache. Vertigo.* Irritability of temper.

EYES.

Protrusion of the eyeballs, pupils dilated. On looking down, the upper eyelid does not follow the movement of globe.

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* Ibid, pages 465, 466, and following.

† See *Medical Union* for October, 1874, page 233. "Three cases of Cerebral Hyperæmia reported by John Butler, M. D."

EARS.

Noises in the ears.

GENERALITIES.

Enlargement of thyroid.

Tumultuous circulation. *Profuse sweating, principally in the axillæ. Cough. Nausea. Increase of temperature, etc.*

Dusch,[1] Eulenberg, Guttman,[2] Neftel,[3] Hammond[4] and many other authorities speak highly of the results they have obtained by galvanization of the sympathetic.

The latter authority says:[5] "The primary galvanic current is undoubtedly the principal agent to be relied upon for the cure of the disease. I first used it successfully in 1865, in the cases of two sisters subject to exophthalmic goitre, who were referred to me by Dr. J. W. Richards. The beneficial influence over all the symptoms was at once perceived, and in less than a month both were free from manifestations of the disease. Since then I have not treated a single case without this remedy."

Dr. M. Meyer[6] records four cases of this affection which were cured by galvanization of the sympathetic.

Professor Roberts Bartholow gives a history of three cases which were successfully treated by this method, of which here follow a synopsis.

Case IV.—Mrs. H., a Jewess, brunette, æt. 32. Her present symptoms began 3 years ago by pain in right side, especially between 5th and 6th ribs. Palpitation of heart, starting terrified from sleep, anxiety and apprehension during attacks of palpitation, suffocative sensation about throat and neck. General health declined; she got out of breath upon the least exertion. Lips and tongue pale, sclerotic pearly-white, appetite poor, digestion slow and painful. *Wakeful at night. Dizziness.*

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[1] Lehrbuch der Herz-Krankheiten, p. 362.

[2] Die Pathologie des Sympathicus. *Greisinger's Archiv*, Band I, Heft 2, S. 453.

[3] Galvano-therapeutics, p. 125.

[4] Diseases of the Nervous System, p. 800.

[5] Ibid, p. 799.

[6] *Berliner Klinische Wochenschrift*, No. 39, 1872.

Singing in the ears, sight dim. Occasional fulness of thyroid and slight exophthalmus. "Abandoning all medicines," he says, "I used the constant galvanic current as the remedial agent. I applied twenty Siemen's and Halske's elements, the negative pole being placed on the epigastrium, and the positive being so applied as to include the cervical sympathetic, the pneumogastric and cilio-spinal region within the circuit. The seances were ten minutes in duration. The immediate effect of the application was to slow the action of the heart to about normal, and several applications caused the almost total disappearance of the unpleasant symptoms.

Case V.—Mrs. R., æt. 54. Palpitation and increased action of heart. Goitre of many years standing. *Vertigo.* Strange sensations in the head. *Sleep disturbed. Noises in the ears.* Digestion disordered. Weakness and huskiness of voice. Pigmentary discoloration of neck and hands. Cachexia. Pulse never less than 96, and during the paroxysms of palpitation, rises to 120, and even to 140. Becomes fatigued very easily, and gets out of breath on making any slight exertion.

Treatment.—The Doctor goes on to say "Recognizing the case as the chronic form of exophthalmic goitre, I commenced at once the treatment by the constant current, using fifteen to thirty elements of Siemen's and Halske's, on alternate days. The applications were made as in the case just described. An immediate improvement took place in the paroxysms of palpitation, and in the pulsations in the neck, and the thyroid rapidly diminished in size. The isthmus still remains hard, and is yet prominent, but the rest of the gland appears now, after four months' treatment, to be normal in size and firmness. The expansile movement of the gland has disappeared, and the unpleasant beating of the carotids are no longer felt. The disorders of digestion have almost entirely ceased, and she is beginning to gain slowly in weight. There has been no decided change in the abnormal pigmentation. The paroxysms of palpitation are less frequent, and much less severe. She is still under treatment; receiving, however, now, but one electrical application each week.

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[1] *Chicago Journal of Mental and Nervous Disease*, Vol. II, p. 344.

Case VI.—Mrs. B., æt. 50. *Very marked exophthalmus* of two years' duration, slight enlargement of thyroid, *palpitations of heart and increased pulse rate. Dizziness and sense of pulsation in ears*, and anæmia. She was treated in the manner described in the two preceding cases, and entirely cured in six months. These cases stand out in bold relief from those we generally find described in old school journals, inasmuch as they were not drugged and dosed with other remedies while under treatment. They are peculiarly instructive and interesting, and did space permit, the entire history would be copied here. The case which follows, is reported by Professor Rosanelli, of Berlin:

Case VII.*—"A girl, æt. 19 (whose father died of progressive muscular atrophy, and whose sister suffers from hemicrania), has from infancy been subject to obstinate diarrhœas and colic. Two years ago she observed a prominence of the eyeballs, some palpitations and general malaise, rush of blood to the face, diarrhœa, swelling of the thyroid gland, loss of appetite and melancholy. With an apparatus of ten elements, the ganglion of the sympathetic was galvanized. Two broad electrodes, covered with sponge, were applied to both sides of the neck, behind the angle of the maxilla, and moved down the margin of the sterno-mastoid, from behind forwards. It was daily applied for two or three minutes, and the direction of the current changed. The physiological action of the current consisted in dilatation of the pupil with every closure of the circuit, more with the negative pole; in contraction of the sterno-mastoid, in secretion of saliva and metallic taste; sometimes vertigo. After one hundred applications the patient was cured. It may be worth while mentioning, that during the treatment she took small doses of Arsenic. She gained twenty-seven pounds in weight, and face and mucous membranes showed a healthy color. The eyes look normal, and the thyroid gland rather small, and without any arterial pulsation. The beat of the heart diminished by forty strokes, and normal, and menstruation regular. She is now as lively as a cricket, and enjoys life as much as any girl of her age."

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* *Med. Centr. Zeitung*, 37, 1877.

CHAPTER VI.

Epilepsy.

The symptoms of this disease are so inconstant, and so variable in character, that it is impossible, with any proximity to precision, to give any list of symptoms that could at all be considered as occurring in the majority of cases we are called upon to treat. In many instances this disease has been cured by electrizing the sympathetic, either in the cervical, dorsal, or lumbar portion; in others, galvanization of the spinal cord is indicated and curative. In a third variety Electricity is not indicated, and consequently will not cure. Numbers of cases have been reported by various authorities as having been blindly experimented upon with Electricity; and it is a fact worth noting, that only in those where this remedy was homœopathically indicated, was any benefit derived.

The case annexed is reported by Dr. Neftel, of this city:

Case VIII.*—"Mr. L., of New York, a married gentleman, forty years old, of a healthy constitution and well nourished, had been suffering for three years with the following symptoms: epileptic attacks, with *complete loss of consciousness*, an intense *headache*, with which he awakens, and which lasts without a moment's suspense for the whole day, especially increasing about eleven o'clock and toward evening, and extending over the whole head. He could not read at all, *being unable to distinguish the letters*, and presented a high degree of amblyopia. It was impossible for him to express his ideas, for *his memory failed him* every time he attempted to speak, and he could not find the necessary words. This latter symptom annoyed him extremely, for he felt himself quite helpless, except for the assistance of his wife and daughter. His family and the patient himself expected insanity, because for the last few years his intellect had been steadily giving way, unfitting him to pursue his ordinary vocation. He had been unsuccessfully treated by several physicians, until Dr. Ceccarini, of New York, sent him

* Galvano-therapeutics, p. 113.

to me, October 11th, 1868. My first impression with regard to the prognosis was very unfavorable. There was evidently some important affection of the brain, some kind of aphasia. The ophthalmoscopic examination revealed optic neuritis. I began to treat the brain with the galvanic current, but without any particular result, his condition remaining the same during a fortnight, and the *epileptic* attacks appearing oftener and severer.* I then proceeded to galvanization of the sympathetic, when soon no trace of the disease remained; and on the 20th of December, 1868, the treatment was at an end. The headache had entirely disappeared. The patient reads and expresses himself perfectly well, and has not had a single epileptic attack since. He is quite healthy, his sight is perfect, and he has long ago resumed his occupation as before the disease."

While we are on the subject, it would be well perhaps, to consider the phases of this disease in which electrization of other portions of the organism is homœopathically indicated. Should we have a case of this disease, where great *pallor of surface and tendency to syncope* are the prominent symptoms, and where the *aura* at the same time proceeds from the pit of the stomach, we would at once think of the similarity of galvanism of the splanchnic nerves and such a case. But will galvanism of the splanchnics cure such a case? Neftel says it will, and he is right. He reports the following case,† which, leaving out his *physiological* (?) theories and deductions, I quote in full.

Case IX.—"A. M., of New York, æt. 7, after a severe diphtheria when one year old, was attacked with epilepsy. The paroxysms at first appeared but once a year, then every month, and afterwards quite frequently. Besides those great attacks, he had several times a day (occasionally eleven times) fits of petit mal.

The parents consulted several eminent physicians in this country and abroad, among them Brown-Séquard. This great physiologist and neuro-pathologist pointed out, as of great importance the aura which invariably precedes every attack. The

* Italics are my own. J. B.

† Galvano-Therapeutics, p. 106.

little patient always grasps with both hands at the epigastric region, where he feels a sudden pain, accompanied by an unpleasant sensation in the head, and *pallor of the face*, immediately after which the epileptic fit follows. Notwithstanding the different methods of treatment during six years, the epileptic attacks continued, and the child finally presented a considerable degree of idiocy, associated with general debility and anæmia. I began at once the galvanization of the splanchnic nerves twice a week, and it was followed at once by a marked beneficial effect. From the very first day, the child *has not had a single attack of epilepsy*, and the petit mal, which before the treatment, occurred many times every day, appears about once a week, and so slightly that it is scarcely noticeable. For the last fortnight he has not had it at all. The general condition has undergone a most remarkable change. The child has a healthy appearance, his intellect is brighter, and his disposition formerly irritable and unmanageable, is now becoming quiet and orderly."

The symptoms in this case were well marked, and are detailed in a manner that we do not generally find or expect in an old school work. The indications for splanchnic galvanization are explicit, and the cure complete.

We may sometimes find cases of epilepsy, where the application of some form of electricity to the spinal cord, or from the mouth to the anus is indicated, and others again where it is necessary to bring all the nervous centres under its influence. A strong current is generally necessary as well as frequent applications, and long seances. Althaus,[1] Hamilton,[2] Beard and Rockwell[3] speak highly of the use of electricity in this affection, and Hammond[4] in the fifth edition of his work on *Diseases of the Nervous System*, reports that he cured fifty-nine cases out of one hundred and thirty, by galvanization of the brain and cervical sympathetic; while in the last edition he ignores the treatment by not even mentioning it. Whether

[1] Medical Electricity, p. 125.
[2] Clinical Electro-Therapeutics, p. 119.
[3] Electricity in Medicine and Surgery, p. 558.
[4] p. 585.

the omission was unintentional, or whether the doctor got tired of the remedy because it would not cure cases where it was not homœopathically indicated, does not appear; most probably the latter; as ever since electricity began to be used as a remedy by the allopathists, it seems to have suffered from a sort of intermittent fever. To-day paroxysm cures everything —to-morrow intermission cures nothing, and like all their drugs when they come out new, are heralded and paraded before the profession, and after a few weeks we hear nothing more of them, until taken up and proved by some member of our school, by whom they are put in their proper place in the Materia Medica.

Hemicrania, or Migraine.

As in the last mentioned disease we rarely meet with two cases of hemicrania presenting exactly, or nearly exactly, the same group of symptoms, still there is a greater approach to uniformity in them, than in those of epilepsy; so much so that we are able to give a group of symptoms which tolerably represent an every-day case.

HEAD AND SENSORIUM.

Excruciating pains in one or other side of head. Temporal artery of the side affected hard and resistant. *Pallor of face*, followed by *redness and increase of temperature* as the attack passes off. *Dizziness. Vertigo. Dimness of sight. Loss of equilibrium.* Soreness of scalp and muscles of neck. Loathing of food and drink.

EYES.

Dilatation of pupil of the side affected. *Muscæ volitantes. Conjunctiva at first pale, afterwards hyperæmic.* Photophobia.

EARS.

Noises in the ears. Sensitiveness to noise.

STOMACH AND GENERALITIES.

Sinking at epigastrium, with nausea and vomiting. Wishes to remain perfectly quiet and not be disturbed for any thing.

These symptoms present the salient points of an ordinary attack of hemicrania. Of course in many cases several of these symptoms are absent or obscurely marked, and in others they are masked by the prominence of other symptoms. Faradism of the superior cervical ganglion of the sympathetic, is as frequently curative in this disease as galvanism, and it is often astonishing, the intensity of current a patient will tolerate in this sensitive region, during an attack, that could not possibly be borne during an intermission, or by the average person in health, contrary to the general rule observed in other diseases. The most marked improvement in all my cases took place after the use of intense currents frequently repeated. Domenico Severi* reports the following case:

Case X.—"The patient, a man æt. 40, suffered frequently from attacks of hemicrania of the left side. Before each attack, the veins of the affected side became turgid, with great increase of temperature of the part. The recurrence of the paroxysm was always as often as once a month, and occasionally occurred oftener, as a consequence of mental fatigue.

An application of electricity from Pizzorno's induction machine was made to the cervical sympathetic, taking care to apply one rheophore along the whole course of the sympathetic in the neck. Length of seance ten minutes. All the symptoms: heat, venous turgesence and pain disappeared.

At the end of a month a new attack came on. Electricity was not used, but it was noticed that the intensity and duration of the paroxysm was less than before.

When the next seizure occurred, electricity was again applied and with success in stopping the attack."

I have treated a number of cases of this disease with electrization of the cervical sympathetic, and all with marked success; even very old standing cases were so much relieved, that the attacks were reduced in severity, and the interval between them very much lengthened; and recent cases in young patients were, I think, without exception entirely cured, and though a number of them were treated several years ago, in only one case, as far as I know, was there any return of the disease.

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* *Galvani* for September, 1874.

Other* forms of headache, such as rheumatic, neuralgic, etc., when the symptoms indicate it, are generally readily cured by electricity; most of them yielding to the galvanic current.

CHAPTER VII.

EYES.

The action of electricity on the eyes is very marked, especially so is the effect of the galvanic current on the retina, and it is to be regretted, that a remedy so potent, is not more used in such diseases of these organs, as it seems so positively indicated.

Amaurosis.

Neftel in his work on Galvano-Therapeutics, page 86, speaking of this affection, says: "The earliest record of the successful use of the galvanic current in amaurosis dates as far back as 1801. The celebrated anatomist, Loder, of Jena, on the advice of Alexander Von Humboldt, to whom he gave instruction in anatomy, instituted experiments on patients of his clinic. He describes in his "*Journal of Surgery*" two authentic cases of aumorosis, cured with the galvanic current by Lichtenstein and Bischoff, and witnessed by himself.[1] Of recent observers I will mention Remak, who was able to convince himself and Graefe of the beneficial effects of the galvanic current in some affections of the retina."[2]

Dr. Driver†, of Chemnitz, has used the galvanic current very successfully in the treatment of this disease, and De Saussure cured a case by statical electricity. Duchenne‡ records a case of paralysis of the retina, produced by the action of the galvanic current, and after relating the case gives the following advice

* Beard and Rockwell, op. cit., page 478.

[1] "Vide Remak, Galvano-therapie der Nerven- und Muskel-Krankheiten, S. 151."

[2] "Op. Cit., page 460.

† Archiv. Otol. and Opthalmology, Vol. III, No. 1.

‡ Localized Electrization, page 17.

to his readers: "By reason of its power to excite the retina, galvanism should be applied to the face with great circumspection. The luminous sensation produced by it is so dazzling that it may injure the sight if too prolonged, the ntermissions too rapid, or the current too intense."

Retinitis.

In retinal hyperæmia we would naturally suppose electricity homœopathically indicated. Neftel* reports a case of that most intractable disease,—retinitis pigmentosa, very much benefited by galvanism; and Beard and Rockwell and other authorities speak highly of it in neuro-retinitis.†

Asthenopia.

Retinal asthenopia is benefited by almost any form of electricity, especially when the symptoms indicating it are well marked. I have had very uniform success with it in my own practice, and Beard[1] and Rockwell report three cases cured by it in their last edition of their "*Medical and Surgical uses of Electricity*," one of which I copy in full.

Case XI.—"A lady, æt. 60, for two years had observed a constantly decreasing strength of vision, associated with a local irritability that precluded any attempt at continued use of the eyes. Finally so weak did the organs become, that she found it utterly impossible to read or sew, or in any way concentrate her sight for a moment, without suffering pain and obscuration of vision. She was treated wholly by localized faradization. The tips of the fingers alone being used as electrodes.

But about twelve applications were given, with the result of complete and permanent recovery. During the three years that have elapsed since this treatment, the sight has remained perfectly strong."

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* Op. Cit., page 87.

† Case of Retinitis caused by Lightning.—*London Med. Gazette*, Vol. II., page 58.

[1] Page 644.

Amblyopia.

Electricity ought to be capable of doing much to relieve this affection, especially the Faradic current. There is very little in medical literature on the subject. Beard and Rockwell barely allude to it "*en passant*," and other recent authorities do not mention it at all. My own experience in the treatment of it has been so far confined to three cases, all of which yielded to daily applications of the induced current; applied negative pole to eyeball, positive to nucha. In two of these cases galvanism was tried first with little or no benefit.

Paralysis of the Muscles of Eye.

Peripheral paralysis or paresis of any of the muscles of the eye, either orbital or ocular, points homœopathically to the electric current as the remedy. Faradism is generally the successful form. Duchenne,[1] Althaus,[2] Meyer,[3] Wells,[4] and other authorities recommend the induced current, and say that it frequently succeeds after the failure of the galvanic current.

Dr. Henry C. Angell[5] in his work on "Diseases of the Eye," says: "When other means fail, paralysis of the ocular muscles, from peripheral or extra-cranial causes, may be frequently cured by electricity.

Faradisation does not appear to be as efficacious as the primary current. Benedict[6] had unusual facilities for testing the value of electricity, at the clinics of Professor Arlt, in Vienna. Of twenty-seven cases all but five were benefitted and seventeen of them cured. Contrary to the generally received opinion, which attributes the benefit to the direct excitation of the paralized nerve, he found that the cure was dependent, generally speaking, upon reflex irritation, through the fifth pair of

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[1] Localized Electricity, p. 17.
[2] Medical and Surgical Electricity, p. 493.
[3] Medical Electricity, p. 378.
[4] Diseases of Eye, p. 568.
[5] P. 248.
[6] His experience seems to differ on this point with that of the authorities before mentioned, as also does Benedict's.

nerves. He found further, that in most cases the curative action was only produced when the excitation was relatively weak. He used from three to fifteen of Daniell's elements. The excitation should only continue about *half a minute* at each sitting, the improvement occurring in most cases *instantaneously*. In operating, the copper pole is generally placed on the forehead, while the zinc pole is in affection of the external rectus, placed over the cheek bone; in ptosis, over the affected lid; in paralysis of the internal rectus, or the inferior oblique, over the side of the nose, at the inner angle of the eye; in case of the inferior rectus, over the lower margin of the orbit; and in paralysis of the superior oblique, on the nose, at the internal angle of the eye. In midriasis, the zinc pole being on the cheek bone, the copper pole should be applied over the closed eyelid."

Conjunctivitis.

It is often astonishing, the rapidity with which either form of electric current will reduce the hyperæmia of the conjunctiva, attendant upon this affection; relieving the pain as if by magic, and, in fact, dispersing all the symptoms. The little engorged blood-vessels can almost be seen to empty themselves, and at the end of a seance of ten or fifteen minutes, the diseased organ often looks as healthy as the unaffected one, and remains so, seldom needing a repitition of the application. But a very mild current is needed; and, if we choose, we may operate upon the part indirectly, through the medium of the superior cervical ganglion of the sympathetic. Inflammatory conditions of other parts of the eye have been treated successfully by the galvanic current.

Nictitation, blepharospasm and hyperæthesia retinæ, are diseased conditions, that frequently point to one or other form of electric current as the remedial agent; and strabismus is occasionally benefitted by it, and even after division of the tendon of the muscle producing the latter affection. Faradism of the opposing muscle is often requisite to restore its tone and vigor.

EARS.

Tinnitus Aurium.

Of all symptoms, produced by the galvanic current on the ear, this one is by far the most constant and most marked; and, for that reason, I place it first on the list of ear diseases requiring electrical treatment. It is a symptom that can always be relieved by the galvanic current, even, when depending upon grave cerebral disease; and, when not so dependant, is readily cured. I would here repeat the caution, before given, not to give too strong a dose, or too long a seance, in treating this organ, as the mischief, that may be done, is incalculable. *No one should think of using electricity, in any form, on the ear, without the use of a Brenner's rheostat;* and we should commence with the current at a minimum, and be sure, not to increase it beyond the amount absolutely necessary to be used.

The case, following, is reported by Dr. G. V. Poore*; and, while I cannot recommend such a rough, slip-shod kind of treatment, is a fair example of what can be accomplished in this complaint by electricity.

Case XII.—"The patient was a middle-aged man, and, when he applied for relief at the Charing Cross Hospital, he was suffering and had suffered for nine months, from that most troublesome annoyance, *tinnitus aurium*. There was, he said, a noise 'like the blowing off of steam,' constantly going on in his left ear. The least jarring of his body, even when walking, was most painful to him, and the roar of the London streets had become intolerable. We will not hazard an opinion as to the pathology of this disease; but it will perhaps suffice to say, that a careful examination of the ear revealed to us nothing physically wrong with it, and that the clearing the ears of wax and the employment of nervine tonics and sedatives had proved of no use. We thought of giving galvanism a trial, and putting one rheophore in the patient's hand; we applied the other to the meatus of the affected ear. He was

* Electricity in Medicine and Surgery, p. 175.

immediately relieved; and, at his visit, a few weeks later, he stated that he had been free from the noise for five days, and it then returned, but not so severely. We repeated the application, and the result has been that he has almost entirely lost his trouble."

Dr. Thos. F. Rumbold, of St. Louis, reports two cases in the *Archives of Electrology and Neurology*,* Vol. I., p. 54, in which the galvanic current proved curative, after he had tried a number of other remedies in vain.

An extremely interesting case is reported by Dr. Friedrich, of this city.

Case XIII.—"M. a Dr. Med., Russian, æt. 29; married, admitted on January 27th, 1874.

History.—Was deaf mute up to his eighth year, when he began to stammer, which he is still doing in a slight degree. Four years ago he was suddenly attacked, at night time, with violent tinnitus in the left ear, that has continued since with varying severity. Patient is nervous and easily excited.

Status præsens.—Otoscopic examination by Professor Politzer.

Right ear.—Perforation of memb. tymp. and otorrhœa.

Left ear.—Normal.

Electro-otiatric examination.—(External appl. electrodes).

Right ear.—13 el. (5° dev. of galv. needle),			Ca.	Cl.	S.†
"	"	"	An.	D.	S.
"	"	"	Ca.	O.	S.
"	"	"	An.	Cl.	S.
"	"	"	An.	O.	S.
Left ear.—12 el. (dev. of galv. needle 3°)‡			Ca.	Cl.	S.
			An.	Cl.	S.
13 el., 3°.			An.	O.	S.
					Same.

Patient being daily galvanized, the tinnitus was, after three

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* *Archiv. Electrol. and Neur.*, Vol. II., p. 47. (Reports of Professor Benedict's Clinics).

† Ca. means cathode; An. anode; Cl. closing; D. duration; O. opening; S. sound.

‡ The deviation of the needle gives no idea of the strength of current used, and only represents the fluctuations in strength of any one battery.

days, already diminished, but still continues; 13 elements were used, and the sitting lasted two minutes. After two weeks' treatment, the tinnitus had nearly disappeared when patient left."

Neftel reports a case of *tinnitus aurium* with *dizziness and headache*, cured by galvanism, at page 74 of his work, already quoted.

Paresis and Paralysis of the Tympanic Muscles.

This disease is often coincident with, and caused by chronic catarrhal inflammation of the middle ear; and not only will the application of the galvanic current cure the nervous lesion, but it will often entirely remove the catarrhal inflammatory condition.

My friend, Dr. Henry C. Houghton, of this city, kindly sends me reports of the following three cases of chronic otitis media, in which the use of the galvanic current proved curative:*

Case XIV.—"Chronic catarrhal inflammation of the middle ear. Dr. A. B., æt. 40. Dec. 11th, 1874. Has had naso-pharyngeal catarrh for a number of years; lately he has noticed that upon attempting auscultation in his daily practice, he was unable to detect murmurs as well with the left as the right ear.

"R. M. E., normal; M. T., normal; E. T., dilatable. Hears, $\frac{20}{20}$. L. M. E., normal; M. T., retracted, but mobile; E. T., dilatable, after two trials by Politzer's method of inflation. Hears, $\frac{24}{240}$.

"After a few treatments it was clear to me that the lesion was due to *lack of motor power in the tympanic muscles*,† as the Eustachian tube was readily dilated by Valsalva's experiment, and the membrana-tympani was easily moved by Siegle's speculum. Hence the galvanic current was employed. The electrodes were placed in such a manner that both the cerebro-

* The italics are my own, and refer to the symptoms produced by Electricity.

† See Pathogenesis, p. 26. Temporary paralysis of any muscle may be caused even by a very moderate electric current. This fact is most easily demonstrable by experiments on the interossei muscles.

spinal and the organic nerve supply to the tympanum, were brought into the circuit, the positive pole being placed over the trifacial in front of the auricle, the negative over the superior cervical ganglion at the angle of the inferior maxillary. For one month the applications were made three times each week.

"Jan. 13th.—Hears, $\frac{5}{20}$. During the second month the treatment was more irregular.

"Feb. 13th.—Hears before treatment, $\frac{14}{20}$; after treatment, $\frac{20}{20}$.

"Feb. 18.—Hears $\frac{20}{20}$.

"Oct. 6, 1875.—The hearing has remained good ever since."

Case XV.—"Mrs. L. D., æt. 30. May 2d, 1877. *Diagnosis.*—Otitis media catarrhalis chronica. *History.*—For a number of years has been dull of hearing; during last six months markedly so. On consulting one of the leading aurists of the world, was told that her case was progressive—would be so in spite of any known treatment, if in a climate similar to that of New York. She was supplied with a Politzer's apparatus, and instructed in its use. Being urged to try homœopathic treatment, she was sent to me.

Symptoms—Objective.—Both membrana tympani depressed, but mobile. Eustachian tube dilatable by forcible inflation, but closed immediately on discontinuing it. Pharynx granular.

Hearing Right.— $\frac{4}{240}$. *Left.*— $\frac{4}{240}$.

Galvanic current applied to the tongue by spatula connected with the positive pole. Sponge electrode in each meatus externa, connected with negative.

After three minutes, R. $\frac{10}{240}$. L. $\frac{12}{240}$.

May 4.—R. $\frac{14}{240}$.	L. $\frac{15}{240}$.	After galv.—R. $\frac{15}{240}$.		L. $\frac{16}{240}$.	
" 7.—R. $\frac{14}{240}$.	L. $\frac{15}{240}$.	" "	R. $\frac{16}{240}$.	L. $\frac{20}{240}$.	
" 9.—R. $\frac{18}{240}$.	L. $\frac{22}{240}$.	" "	R. $\frac{30}{240}$.	L. $\frac{30}{240}$.	
" 11.—R. $\frac{21}{240}$.	L. $\frac{32}{240}$.	" "	R. $\frac{36}{240}$.	L. $\frac{5}{20}$.	
" 14.—R. $\frac{40}{240}$.	L. $\frac{5}{20}$.	" "	R. $\frac{5}{20}$.	L. $\frac{10}{20}$.	
" 16.—R. $\frac{6}{20}$.	L. $\frac{12}{20}$.	" "	R. $\frac{8}{20}$.	L. $\frac{16}{20}$.	
" 18.—R. $\frac{10}{20}$.	L. $\frac{14}{20}$.	" "	R. $\frac{14}{20}$.	L. $\frac{18}{20}$.	
" 21.—R. $\frac{12}{20}$.	L. $\frac{16}{20}$.	" "	R. $\frac{20}{20}$.	L. $\frac{20}{20}$.	
" 23.—R. $\frac{18}{20}$.	L. $\frac{18}{20}$.	" "	R. $\frac{20}{20}$.	L. $\frac{20}{20}$.	

June 1st.—Hearing remains normal, and hears all sounds as well to day as any member of the family."

Case XVI.—"D. L., æt. 40. May 11th, 1877. *Diagnosis.*—Otitis media catarrhalis chronica.

History.—After pneumonia noticed a slight loss of power and a subjective noise. Convalescence being established, and *tinnitus* continuing, came to me for advice,

Present condition.—Right and left membrana tympani depressed, and adherent at the long process of manubrium; the remainder of the membrane fairly movable by Siegle's speculum. Eustachian tube dilatable. Pharynx varicose, and of weak, flabby texture. Hears, R. $\frac{7}{40}$, L. $\frac{3}{20}$. The electrodes were applied upon the trifacial in front, and upon the mastoid process behind the auricle. The line connecting the two being parallel with the antero-posterior diameter of head, and a gentle current allowed to run two minutes. Then the commutator was used one minute.

Hearing.—R. $\frac{20}{20}$. L. $\frac{18}{20}$., *and the tinnitus had ceased.*

May 14th. Hears, R. $\frac{14}{20}$. L. $\frac{14}{20}$. Current applied as at last date, for same length of times.

After seance.—R. $\frac{18}{20}$. L. $\frac{16}{20}$.

May	19.	Before seance.—	R. $\frac{10}{20}$.	L. $\frac{10}{20}$.	After,	R. $\frac{16}{20}$.	L. $\frac{16}{20}$.
"	22.	"	"	R. $\frac{10}{20}$.	L. $\frac{10}{20}$.	"	R. $\frac{16}{20}$.	L. $\frac{16}{20}$.
"	26.	"	"	R. $\frac{12}{20}$.	L. $\frac{12}{20}$.	"	R. $\frac{16}{20}$.	L. $\frac{16}{20}$.
"	29.	"	"	R. $\frac{20}{20}$.	L. $\frac{20}{20}$.	"	Same.	

June 11th. Remains same. The fact that adhesions exist in the tympana makes the prognosis less favorable, but injections of the Iod. potas. and the application of the current for its chemical and mechanical effects would be suggested if the future of the case should demand it."*

Dr. Houghton, in a private letter I lately received from him, on the subject of "Electricity in Ear Disease," says: "In cases of *hyperæsthesia of the nerve*, galvanization seldom fails to modify or abolish the subjective sounds."

"*In torpor of the nerve.* The galvanic current is a valuable remedy as shown in the case before the last recorded. The doctor's method of applying electricity to the middle and internal ear is a very ingenious one, and will be given in full in

* For a number of cases treated by galvanism, see *N. Y. State Transactions*, 1873–4, p. 469.

another chapter, when we come to consider the methods of using electricity.

Nervous deafness, hysterical deafness, otalgia, and even deaf-mutism, have all been benefited and cured by the galvanic current.

Duchenne* reports five cases of nervous hysterical deafness cured, and several cases of deaf-mutism improved by Faradism.

Brenner† also records a number of cases, as well as one case of thickening of the typanum, in which latter the galvanic current caused absorption.

There is no lack of literature on this subject as the works of Moos, Erb, Neftel, St. John Roosa, Hagen and others testify. The use of the galvanic current in aural diagnosis will be alluded to again in a future chapter, as will also its mechanical action in breaking up adhesions, etc.

CHAPTER VIII.

NOSE.

The proving of electricity on this organ is more meagre in detail than perhaps that of any organ in the body. However, we would expect it to be a useful remedy in some cases of catarrh, acute coryza, anosmia and ozœna.

CATARRH.

The subjoined cases occurred in my own practice, which on account of the paucity of cases reported by other authorities, I here give in full.

Case XVII.—Mrs. T., æt. 33, a woman of phlegmatic temperament, and who, aside from the disease under consideration, has always enjoyed very fair health, suffered from nasal catarrh of six years' standing. *Secretion profuse and thick*, and of a greenish color; ethmoid and turbinated bones somewhat de-

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* *Diseases of the Ear*, translated by Roosa, 2nd Edition, p. 1013, et. seq.

† *Untersuchungen und Beobachtungen auf dem Gebiete der Electro-Therapie*, Band I., 2 Abth., S. 233.

nuded. No resonance to voice. Follicular inflammation of pharynx, with thick, viscid secretion. Breath extremely offensive. Complete loss of taste and smell.

Treated by galvanic current by means of a douche made for that purpose, negative pole being applied to the seat of the disease, positive to some indifferent point. This treatment of five to ten minute seances was repeated twice a week. At the end of six weeks, taste and smell were fully restored; and at the end of four months the disease was entirely removed.

Case XVIII.—Miss P., æt. 19, of rather a strumous habit. Nasal and Eustachian catarrh for two years. *Secretion profuse, yellow and thick.* No ulceration could be discovered. Partial deafness. *Loss of smell.* Fetor of breath. Was treated as the previous case, and entirely cured in five months.

A number of other cases have been successfully treated, and perhaps at some future time will be reported elsewhere.

Beard and Rockwell* report one case of eight years' standing, and of a most persistent and annoying type, which was cured entirely in four months; the patient having had during that time sixty applications of the galvanic current.

Coryza.

In acute coryza the faradic current gives rapid relief; especially in cases where darting pains extend into the frontal sinuses, with a sense of stuffiness and fulness in the head. The authorities last quoted explain its action by saying:† "Aside from the chemical effect of the current, its mechanical action alone would be sufficient to theoretically account for the relief it gives to inflamed mucous membranes."(!) Although a little farther on, on the same page, occur these lines: "Its primary effect is to increase the amount of blood in the mucous membrane to which it is applied, and experience shows that this hyperæmic condition thus created soon passes away."

In other words, these gentlemen cure hyperæmia of mucous membranes, by a remedy that in health produces hyperæmia,

* Op. cit., p. 683.

† Op. cit., p. 683.

and still will not acknowledge the homœopathy of the cure, but make a bungling explanation of how it takes place; which, to say the least, is an extremely unsatisfactory one.

Anosmia.

This symptom, when caused by a peripheral lesion, may be relieved by either galvanism and faradism. In my practice, however, I have generally got the best results from the use of the galvanic current. The last mentioned authors, on the same page of their work, just quoted, give the accompanying case.

Case XIX.—"Mr. H. L., a medical student, æt. 30, was referred to us by Dr. Roosa, May, 1869. Some six years previous the patient had fallen from a horse, and sustained severe bruises about the head and face. From that time he had been unable to distinguish any odor, with the exception of that of fresh-ground coffee and kerosene oil.

A powerful application of the faradic current was made on either side of the bridge of the nose, near the eyes, enabling him in a few hours to smell certain strong perfumes.

On the following morning he was surprised to find himself able to smell tobacco-smoke, camphor, etc.

His sense of smell remained thus acute until three or four in the afternoon, when it suddenly disappeared.

A second application was followed by the beneficial result of the first, and with only a partial relapse, while the third and fourth seances rendered him sensible to most of the ordinary odors." This was a remarkable cure. All my cases were much longer under treatment, but most of them were complicated with nasal catarrh. In such cases the anosmia was the first symptom to disappear, which it generally did at the close of the fifth or sixth week of treatment.

MOUTH, TONGUE, TEETH, ETC.

Odontalgia.

Toothache, from hyperæsthesia of the dental nerve, may often be benefitted by either form of current, and there are

cases on record, where the pain has been checked instantly, by discharges from the Leyden jar. Frommhold devotes a chapter to this subject, in his "*Electro-Therapie, mit besonderer Rücksicht auf Nerven-Krankheiten;*" it is well worth perusal, but too long, to be more than alluded to in these limits. In this country, as this disease rarely comes under the care of a physician, I have but little to say, personally, on the subject. I have applied the faradic current in one or two instances, however, with almost immediate benefit.

Loss of Taste.

This is one of the most prominent symptoms, produced by galvanism, in this region. In cases of naso-pharyngeal catarrh, where it is present, it generally disappears soon after the sense of smell is restored, under the same treatment, as in the case of Mrs. T., before mentioned. There is nothing, that I know of, in medical literature on this subject; but it is certainly a matter that would repay further investigation.

Salivation.

From the proving of both forms of electric current, one would naturally be led to expect good results from their exhibition in that often intractable trouble, salivation in pregnancy, which is frequently so very unamenable to ordinary remedies. I regret exceedingly, that I have no experience, in this matter, to offer to the profession; and all I can now say on the subject, is, that it is a question still to be decided by further research and experience.

Paralysis of the palate, tongue, face, etc., will be alluded to further on, under the heading of Peripheral Paralysis.

CHAPTER IX.

PNEUMOGASTRIC NERVE.

A study of the effects, produced by electricity on this nerve, opens us a large field for conjecture and speculation, as to its

probable uses in therapeutics. It is, indeed, full of fertile suggestions. The symptoms produced by it on the organs controlled by this great nerve, are so entirely different to those of any drug remedy, supplying a deficiency in the Materia Medica, in the treatment of those very diseases that hitherto were considered most intractible, and often entirely incurable, that even were it deprived of its effects on other organs in the body, every physician in our school should welcome its enrolment among our list of therapeutic measures.

The first symptom, given under the heading *Pathogenesis*, is

Spasm of Glottis.

The renowned Laryngoscopist, Tobold, in his work, speaks of a case he cured by central galvanization; that, of course, gives us no very definite information, although, what is known in the old school as central galvanization, includes the pneumogastric nerves in the circuit; and it requires no very great stretch of imagination to assume, that the cure of his case was due to the effects of the current on this nerve; it being the only part included in the circuit that gives this symptom in the proving.

Asthma.

Of the other symptoms of the current on this nerve the first group present a very excellent picture of a case of asthma. We have prominent: *The contraction of the muscular fibres of the bronchial tube. Respiration accelerated,* even to tetanic respiration. Spasmodic breathing and cough, and difficulty of inspiration*, together with a *sense of suffocation.* Now, will electrization of this nerve, cure asthma? We have abundant proof that it will.

Neftel† reports the three cases, which here follow.

Case XX.—"Mr. P., æt. 43, commenced to be asthmatic in

* The most noticeable acceleration seems to be in inspiration. The expiration seems to be prolonged.

† *Galvano-Therapeutics*, p. 153.

his ninth year, after whooping-cough. The symptoms at first slight, increased every year in severity and frequency, until they assumed the true character of asthma, appearing in paroxysms, between which the patient had no difficulty of breathing. There were especially some circumstances, which would always call forth an attack; for instance: some articles of diet, and especially a late dinner. Sexual intercourse would invariably be followed by an attack, and so also would the least cold. There were some places, or houses, where he could never remain over night, without suffering from asthma, while in others, on the contrary, he felt quite free from it. In this case the galvanization of the pneumogastric (anelectrotonus) was followed immediately by a beneficial effect. Since the first treatment, which was occasionally repeated, the patient has not had a single attack during the remainder of the winter, although he was out every day, even in the most inclement weather."

Case XXI.—"Mrs. C., æt. 30, sent to me by Dr. Marion Sims, December 9th, 1868. She has been affected with severe asthma from her childhood, and different kinds of treatment have been used without any benefit. Galvanization of the vagus (catelectrotonus) has immediately relieved her from an attack, and she remains still free from asthma, after having been treated fifteen times." (1873).

Case XXII.—"Mr. J., æt. 35, suffered from severe asthma, for which he had been treated by many excellent physicians. Dr. Elsberg sent him to me September 21st, 1869, during an intense attack, which had already lasted for a fortnight, entirely depriving him of sleep. After the first application of the galvanic current, by means of which I endeavored to produce a condition of anelectrotonus of the vagus, he slept very comfortably the whole night, and the paroxysm disappeared."

The reader will observe, that in the treatment of these cases, two of them were treated by the descending current and one by the ascending, and the results, as far as the cure was concerned, were identical. Benedict, Beard and Rockwell,[1] Wil-

[1] Op. cit., 2 cases reported, p. 554.

son Phillip,[1] and many other authorities, speak in the highest terms of this method of treating asthma.

Pertussis.

I am afraid, that electro-therapeutists generally have been extremely negligent, in prosecuting experimental research in this direction; and, I believe, to Neftel[2] belongs the credit of being the first to bring the matter to the notice of the profession. He, however, says, that his observations are not sufficiently matured for publication (1873). But, I sincerely hope, he will throw some light on the subject, at a time not far distant.

The cases, I have myself treated, have been too few, (and were all taking other remedies at the time they were under treatment), for me to hazard an opinion on the subject. However, this is a legitimate field for further experiment, as fully warranted by the proving.

Hay Fever.

Autumnal or summer catarrh, or rose cold—called also hay asthma, and by a hundred other synonyms, has of late years been treated considerably by electricity. Neftel[3] gives a case in his work, cured by galvanization of the vagus. Dr. W. F. Hutchinson, of Providence, says he is quite successful in breaking up the attacks. Drs. Beard and Rockwell[4] allude to this method of treatment, and recommend its use.

Angina Pectoris.

This is an affection that from the proving certainly ought to be amenable to electrization of the vagus. Beard and Rockwell[5] report three cases. One case derived decided relief from central galvanization. (This grape-shot process, as was before

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[1] 22 cases treated in the Worcester Infirmary, and all cured.
[2] Op. cit., p. 156.
[3] Op. cit., p. 688.
[4] Op. cit., p. 156.
[5] Ibid, p. 668, et seq.

remarked under this heading, includes the pneumogastric nerve, part of the time of the seance, in the circuit). A second case was *aggravated* by *strong galvanization*, and afterwards relieved by *mild*, *general faradization;* and a third case, that also recovered under general mild faradism.

Dr. G. V. Poore reports the following case.*

Case XXIII.—P. M.. æt. 42, admitted into the Seamen's Hospital, for angina pectoris, under Dr. Ralfe, Feb. 24th, 1874.

History of attack.—Four weeks before admission, whilst engaged at his work on board ship, had a sudden attack of acute pain, starting from the cardiac region and then coursing down the left arm as far as the fingers. This was accompanied by a feeling of great oppression in the chest. Has had three or four attacks since.

Present condition.—Aged appearance; grey hairs plentiful; slight arcus senilis; pulse slow, weak, intermittent; enlarged area of cardiac dulness. Was treated with spirits of chloroform and Hoffman's anodyne, at first. Had several attacks of pain. The voltaic battery was then ordered, March 10th. After the third application patient felt much better, the pain being less severe. About thirty cells of Foveaux' battery were applied. Still better after a fourth application.

The method of application was to place the negative pole to the nape of the neck, and the positive over the cardiac region, and down the inner side of the arm. Dr. Ralfe, writing in reference to this patient, says: "Not only is the pain less, but the general appearance had improved greatly. He looks less aged and anxious. The pulse, which at first was very irregular, is now steady, though feeble."

Diabetes Mellitus.

Cl. Bernard,† in experimenting on dogs, found that temporary diabetes occurred in those in which he faradized the pneumogastric nerve. This, I believe, was the first instance in which the symptom was noticed; at least it is the earliest men-

* Op. cit., p. 165, et seq.

† Leçons de Physiologie experimentale, 1856. Tome I.

tion of the fact, as far as I can discover, in any medical work or journal. Later, Duchenne* discovered that the same occurrence took place in the human subject. He says: "I cannot leave this subject without mentioning an experiment that I made upon a man, after faradization of the pneumogastric. I examined his urine (once only it is true), and discovered the presence of glucose by the usual tests (liquor potassæ and Barreswell's solution). There was no glucose in his urine ordinarily." Afterwards this fact was noticed by a number of other authorities, and now it is an established truth well known to the profession in general. Acting upon this hint, in 1873, I treated two cases of diabetes by faradizing both vagi, after Duchenne's method (to be hereafter described); the sugar gradually lessened in quantity, as did also the amount of urine passed, and finally disappeared, and the men are to-day (1877) hale and hearty. These cases have already been reported elsewhere,† or they would be given here in detail. As these kind of cases are not ones generally sent to an electro-therapeutist, my experience in treating them has thus far been very limited; in fact these are the only cases in which I have had an opportunity to try the experiment.

Althaus,‡ in the new edition of his work, makes these remarks: "Whatever may be the nature and causation of diabetes, there can be no doubt that the parts forming the floor of the fourth ventricle, and more particularly the roots of the pneumogastric nerves, play an important part in its production and continuance.

It is likewise certain that the continuous current, when applied to the pneumogastric, is transmitted to the floor of the fourth ventricle, and galvanization of the pneumogastric seems to be the rational remedy for diabetes. Signor Mariano Semmola§ states that electrization, both by the continuous and induced currents, causes in diabetic patients a diminution of the quantity of sugar excreted, and sometimes also of the quantity

* Op. cit., p. 104, et seq; published 1871.

† Medical Union, June, 1874.

‡ Op. cit., p. 624.

§ *Comptes Rendus*, 1861, Vol. III., p. 399.

of urine. The results of the treatment are said to be either temporary or permanent. When the patients recover, he believes them to have suffered from an idiopathic neurosis; but where the results were temporary, he suspects the presence of structural lesions in the floor of the fourth ventricle." Now here are two men who stand at the very head of the profession in Europe, in the department of electro-therapeutics, who know that galvanization and faradization of the vagi will both cause and cure excretion of sugar in the urine—will both produce and counteract an excessive flow of urine—and still will not admit that there is even one grain of truth in the doctrine taught by the immortal Hahnemann. It is very probable that these authorities are quite right in their location of the lesion; indeed we have every reason to believe it is so situated. Dr. William Dickenson* made post mortem examinations of a number of patients who died of diabetes, and found this to be the fact, but in many of them there were also pathological changes in the spinal cord, medulla oblongata, and in other parts of the nervous centres. This seems to correspond with the experience of other and later authorities. But surely these pathological facts do not "*point to electrization of the pneumogastric as the rational remedy* as Dr. Althaus says. Will any homœopathic physician accept such an explanation as to how the cure takes place? Surely not. There is only one explanation, and a very plain one: galvanization, or faradization of the pneumogastric nerves cures diabetes, according to the law of similars.

Nausea and Vomiting.

The effect, produced on the stomach by electrization of the lower ends of the vagi, is very marked, in causing gastralgia, nausea and vomiting. The symptoms are first mentioned by Bernard and described by M. Meyer,[1] and are constant symptoms with a strong current; and even sometimes, in very sensitive patients, occur after using a very medium strength. Dr. Frederic D. Lente, of Cold Spring, N. Y., re-

* *Med. Times and Gazette*, March, 1870.

[1] Medical Electricity, p. 86.

ports eighteen cases of vomiting, of the most troublesome and intractable types, entirely cured by a faradic current, transmitted from spine to pit of stomach. This included the lower part of the pneumogastrics in the circuit; we cannot, therefore, but conclude, that the cures depended upon the effect the electricity produced on these nerves. All his cases, with one or two exceptions, began to improve after the first treatment; and these were *first aggravated*, temporarily, by too strong a dose, and afterwards cured. M. Le Coniat,* a French physician, presented a paper to the New York Medical Association, on the treatment of sea-sickness by the faradic current; but, unfortunately, he combined the use of atropine with his treatment, which, of course, destroys the value of his experiments. He says, that ninety per cent. of his cases were cured. These facts, I think, should justify us in enlisting electricity as a remedy for the obstinate vomiting that occurs sometimes in pregnancy, and so often resists all ordinary treatment, and sets, both patient and physician, at their wits' end; also in the vomiting that supervenes in cases of puerperal fever, and, in fact, wherever we meet this symptom, where it is not controllable by drug medication. I am not aware of galvanization of the vagi ever having been used as a remedy for gastralgia; but this symptom often yields to topical applications of the faradic current to the pit of the stomach; indeed, it sometimes seems little short of magical, how a seance of one or two minutes will lull the pain, even, when caused by chronic organic disease.

Heart and Lungs.

The treatment of diseases of these organs, by electrizing the vagi, has met with but little attention at the hands of the electro-therapeutists; in fact, it is scarcely alluded to in any work. Beard and Rockwell[1] say, that "Fliess experimented with the galvanic current in twenty-four cases of heart trouble, nineteen of which were functional, and five of an organic character.

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* *Archives of Neuralogy and Electrology*, Vol. I, p. 193.

[1] Op. cit., p. 667.

All the cases were more or less relieved, even those, dependant on structural lesion, while the majority of the cases were permanently cured.

His method of treatment was daily application to the pneumogastric in the neck, of mild, descending galvanic currents, for one or two minutes. Temporary abatement of the symptoms followed each application." What the symptoms were, that were abated, they do not say, and it certainly is not likely that the whole twenty-four cases presented the same group of symptoms. There is not much, that is definite, to be learned from these *very general* observations; but they serve to show that there is a wide field of usefulness in the future of this method of treating some cardiac difficulties; a whole territory indeed, as yet unexplored and full of promise.

In lung diseases medical literature is, if possible, more barren of information. I can find *nothing* trustworthy at all on the subject. It is true, that there are some astounding assertions made by one man, with regard to the cures he has made of a great number of cases of phthisis, even when in advanced stages; but, I regret to say, they do not bear the stamp of truth, and for that reason I forbear even recording the name of the author. As far as my own experience goes, I do not believe, that disease affecting the lung structure itself, is at all influenced by any form of electricity applied to the pneumogastrics; however, at the same time, I must say that I do not feel qualified to give that as a positive opinion; but, judging from the provings of the current on the healthy nerve, and what little clinical experience I have had in these diseases, I am strongly impressed with the idea, that it is not homœopathic to diseases of nutrition, affecting parenchyma of the lung.

Cough.

There is a cough very similar to that of rumex crispus, or lachesis, produced by galvanizing the central portion of the vagi. There are some patients so extremely sensitive to the action of the current, that even when administered to them in the mildest possible degree of intensity, this symptom becomes

so annoying, as to necessitate a discontinuance of the seance. These are of course very exceptional cases; but I have never met with a patient, who could not be made to cough by a very moderate current. It is most easily caused by closure of the cathode, next by opening of the anode, and is most difficult and requires a current that cannot be used with safety, to cause it at duration. As far as I can gather, I know of no instance of this symptom having been made any clinical use of. Possibly it might prove useful in hyperæsthesia of the larynx, with nervous cough, where the symptoms are not quite covered by any drug remedy. Before leaving this subject, I would call special attention to the fact, that in the hands of tyro-electro-therapeutists, electrization of the vagi is an operation that is full of danger, indeed, no matter how experienced a physician may be in this department of medicine, it behooves him to proceed with a great deal of caution, and to recollect that he cannot commence his seance with too mild a current, and that *he must not increase it beyond the point at which the patient is conscious that the current is being transmitted.* It may be well here to quote Duchenne's opinion on the subject. *

"This procedure is not always free from danger. I need only recall the important organs that are subject to the pneumogastric, in order to impress upon my brethren the need of great caution in similar researches. The following accident occurred in my practice, and may serve as a warning to others. Whilst moving a rheophore over the lateral and superior parts of the pharynx, with a current of rapid intermission, but moderate intensity, the patient fell suddenly into syncope. When restored, he said he had experienced a kind of suffocation and an indefinable sensation.

Since then having faradized the pneumogastric many times, and at the same height, with one intermission per second, and with a very moderate current, the same accident has not occurred, but the præ cordial sensation has been felt every time. I once saw the necessary caution neglected, in faradizing the pharynx of a young man in whom that organ and the velum

* Op cit., p. 104.

palati were paralyzed, consecutive to an angina. A profound syncope was immediately produced by the operation, and in this case I have no doubt that the pneumogastric had been irritated by the current." Several years ago a very similar accident occurred in my own practice. While faradizing the soft palate, the patient happened to turn her head around, and the electrode slipped off the palate and on to the posterior and lateral part of the pharynx, just over the seat of the pneumogastric nerve, and although the current could not possibly have acted upon the part for more than a fraction of a second, an immediate swoon was the result. Though considerably alarmed for the safety of my patient, I could not help comparing her condition with an ordinary fainting fit. In the latter the patient begins to feel sick, cold perspiration appears, he turns deathly pale and finally falls. But this patient, to use a common expression, "fell all in a heap," muscles totally relaxed, eyes set, face gradually turned pale, and I think she must have remained in this condition half an hour. All the ordinary means of favoring resuscitation having been used, she finally showed signs of returning vitality; but only for a moment or two, when she again fainted, and continued to have fainting spells of a few minutes duration, with only short intermissions, all the forenoon of that day. She could not afterwards describe any of her sensations. The period of her fainting and awakening until she finally came to, seemed to have been one of total oblivion. I hope that these warnings may prove of service to such of my readers as contemplate administering this remedy, and that it may save them having a case of the kind to treat or record.

CHAPTER X.

SPLANCHNIC NERVES.

In speaking of epilepsy, page 37, we entered fully into the symptoms of that disease in which galvanism of these nerves appeared to be indicated. What was then stated, embraced pretty much all that we have to say in regard to the first

symptom of the proving. The second symptom is:—Peristaltic motions of intestines cease. I have but little to say with regard to the utility of this symptom in clinical practice. It was first described as before mentioned by Pfluger, and the current seems to act in producing both symptoms, by its effect on the vasomotor nerves: causing engorgement of the blood-vessels of the intestinal canal, and at the same time depriving the brain of its accustomed blood supply. Hence pallor of countenance—peristaltic motions of intestines cease. Electrization of this nerve might be tried in obstinate constipation, caused by a deficiency of peristaltic action. It certainly seems as if it were homœopathic to the condition.

PHRENIC NERVES.

Electrical stimulation of these nerves has mostly been made use of antipathically in cases of suspended animation, as from drowning, etc., in order to produce contraction of the diaphragm, and thus assist in keeping up artificial respiration.

Homœopathically it ought to cure spasmodic action of the diaphragm, hiccough, etc. I once used it successfully in a case of obstinate hiccough. It is very difficult, however, to make a satisfactory application of electricity to the phrenic nerves, without at the same time influencing both the sympathetic and pneumogastric, except in very lean persons, in whom the muscles of the neck (which act as land-marks) stand out in bold relief. Beard and Rockwell, mention two cases of obstinate hiccough, which they claim to have cured by galvanization of the sympathetic and pneumogastric. It is possible that the cure may have been due to the galvanization of the vagus; as electrization of that nerve produces hiccough, but not in the same degree as electrization of the phrenic; but it is not at all likely that the effect of the current on the sympathetic nerve had anything whatever to do with the cure; and taking into consideration that in the ordinary methods of galvanizing, the pneumogastrics, (that is outside the neck), the phrenic nerves must be included in the circuit. I think galvanism of the phrenic is entitled to the credit of the cure. Certainly it is entitled to as large a share of it as the pneumogastric.

CHAPTER XI.

SPINAL CORD.

Electrization of the spine is used, or rather abused for every possible form of nervous disease, whether it is indicated or not. It is a "dernier resort" for the old school to fall back upon, whenever they don't know exactly what to do for a case. "Try electricity along the spine," they say. Well, how do they *try it*? An old second-hand magnetic machine is often borrowed and the handle turned by a cook, bottle-washer, or stable boy, and the electrodes manipulated by a well meaning daughter or son of the patient. Up and down, the spine is rubbed with the sponges, or worse still, with the naked metallic electrodes. At one moment the patient feels no current, at the next he screams with the pain. The person applying it is frightened, the young man at the "wheel" is scared. The patient feels much worse, but *electricity has been tried*, and failed. The treatment was too severe. The shock produced by it on the nervous system was too great, and so poor electricity gets blamed for the ignorance of the doctor, and the short-coming of the nurses.

In applying electricity to the spine, other parts, as portions of the great spmpathetic, pneumogastric roots of the spinal nerves, etc., are unavoidably included in the circuit, so that in addition to the symptoms given under the sub-heading, *Spinal Cord*, page 20, we have also a number of the symptoms which are recorded under *sympathetic*, etc. Practically, however, this is a matter of no importance whatever, as the location to apply the current is the principal point to know after all; and if we understand that, by applying a pair of rheophores to certain points of the body we produce or cure a certain train of symptoms; I do not think it makes much difference whether the patient is cured by the action on one or the other tissue, that is as long as it is utterly impossible to electrize one, without at the same time affecting the other.

Electricity is often useful in spinal anæmia, congestion, in many forms of spinal paralysis, epilepsy, chorea, backache of

women of uncertain pathology, spasm of single muscles, as torticollis, etc., and even in tetanus it is frequently indicated, and we have on record many cases of this latter affection, which have been cured by its use.

Spinal Anæmia.

The characteristic symptoms of spinal anæmia differ somewhat according to location at which it exists. We will therefore take up for consideration the different parts of the spine in their order from above downwards.

Cervical region.—Tenderness over seat of the disease. *Vertigo. Noise in ears. Muscæ volituntes. Headache. Insomnia.* Neuralgic pains in cervical region. *Clonic spasms. Contraction of muscles, supplied by nerves issuing from cervical region. Nausea. Pains in stomach. Aphonia. Hiccough, etc.* Some one or more of these symptoms are often absent, or obscurely marked, but no matter which one is absent, we have in this affection a complete picture of a proving of the electric current.

Dorsal region.—*Tenderness. Gastralgia. Nausea. Vomiting. Pyrosis.* Acidity of stomach. *Palpitations of heart,* and irregularity, occasional attacks of *syncope. Difficulty of breathing, cough. Intercostal neuralgia, spams* of *muscles* or *paralysis,* occasionally *epileptiform convulsions.*

Lumbar region.—*Tenderness.* Neuralgia affecting thighs, legs, and muscles of the back. *Difficult urination. Incontinence of urine. Pain in uterus, ovaries and rectum. Contraction of muscles of lower extremities, paralysis.*

In many cases we have any two of these regions affected, commonly the cervical and lumbar, or cervical and dorsal regions, and occasionally the whole spine.

A favorable prognosis may almost always be given in this affection, although long standing cases are sometimes troublesome at first. I can call to mind no instance of persevering treatment by one or other form of current having failed to make a complete and perfect cure.

Hammond[1] remarks: "There is a remedy which apparently

[1] Op. Cit., p. 404, and seq.

either contracts or enlarges the diameter of the blood-vessels, and which is more efficatious in removing spinal irritation than any other with which I am acquainted, and that is the direct galvanic current." This authority on the pages immediately following this quotation, reports a number of cases illustrating the force of these remarks. Beard and Rockwell[1] also record several cases. Dr. W. F. Hutchinson,[2] of Providence, R. I., has on record the annexed case.

Case XXIV.—"Mrs. M., æt. 40, native of Rhode Island. Has suffered for two years from spinal irritation in so advanced a state as to call for medical interference, during which time she was seen by a number of physicians, returning finally to where she should have remained from the first, to the care of her family attendant, Dr. Baker, by whom she was placed under my charge. The symptoms were *nausea*, great distress after meals, flatulence, and *persistent insomnia. Pain was almost constant*, and was of neuralgic lancinating character, extending from the cervio-occipital region down the spine as far as the first lumbar vertebra, and thence around the waist, giving the sense of constriction which we usually notice in spinal irritation.

Menstruation was regular and bowels in excellent condition, considering the quantities of drugs aimlessly given by various charlatans whom she had consulted. The difficulty most complained of was sleeplessness. "If I can only sleep, Doctor, without an anodyne, I shall soon get well." Concurring in this opinion and believing that the case was one of general nervous hyperæsthesia, induced by spinal irritation, a careful examination was made of the column. Firm pressure with both thumbs over the transverse process was steadily carried down from the nape of the neck, but no sensitive spot was found. With a small rubber-tipped hammer and pleximeter, percussion was practiced upon the body of each vertebra successively, with a negative result, until the first lumbar was reached, when she exclaimed: "O Doctor, that goes through

[1] Op. Cit. p. 449, et-seq.

[2] Archiv Electrol. and Neurology, p. 66, and seq.

me like fire!" No amount of pressure my thumbs could make would produce this result, which a slight tap repeated.

Treatment was at once commenced with the same battery* previously employed, in the following manner: Upon a stool which is fitted with a copper plate in the centre of the seat, covered with sponge, the patient was seated in such a manner as to cause the coccyx to press firmly upon the plate, to which was attached the cathodic pole cord, the anode being a carbon plate, two inches square, also sponge covered. The latter was strongly pressed against the seventh cervical vertebra, and the current from four cells turned on. No sensation being felt, the force was gradually increased to ten cells, when she felt, as she expressed it, a current as if of warm water flowing down her back as far as the painful point, and thence all over and through the pelvis. The first application lasted ten minutes, with the ordinary soothing effect, and the patient was directed to abstain from her usual anodyne at bed-time, taking in its place a cup of strong beef-tea, and to return the next day. Next day came and with it Mrs. M., jaded and worn from a restless night. The same mode of application was practiced, with the addition of two or three rapid reversals of current, by means of the commutator. Next day, she reported about an hours sleep, and, to make a short story, from this time until complete recovery from every symptom was established, a period of three months, the upward march was with a steady step, and but few back slidings. To-day, four months since, I last saw the lady, her husband tells me that she continues in excellent health."

I have selected this case to show that even when applied in the most bungling, unscientific manner, electricity will sometimes affect a cure. There is no doubt in my mind that if in this case a current of a much less intensity so applied, that its force would be concentrated as nearly as possible in the painful spot, and without the use of the rheotrope (to which Dr. H. gives so much importance), that the cure of this case would have taken place much sooner. All Dr. Hammonds cases, just

* Siemens and Halske's as made by the Galvano Faradic Mf'ng. Co.

alluded to, (but which were correctly treated), were cured in a very much shorter time. The average time under treatment being five weeks.

SPINAL CONGESTION.

This affection has a great many symptoms that also exist in the disease last described. The salient symptoms of an ordinary case of this disease are: *Heat in the part affected*, with *a dull aching sensation* but *no* tenderness on pressure. *Paralysis* or *paresis*, with *anæsthesia* or else *hyperæsthesia* of the parts of the body below the location of the difficulty. *Twitching* of *muscles. Darting pains along the nerves.*

When the congestion exists in the cervico-dorsal region, there are *dyspnœa* and *palpitation* of the heart. When below that point, difficult urination, with incontinence, constipation but involuntary evacuations. Pain and sense of constriction of chest and abdomen. We certainly have symptoms enough here characteristic of the efforts of electricity, to warrant us prescribing it in a case of the kind. Hammond[1] says: "Electricity is always useful. The constant current should be applied to the spine over the part affected, and the intensity and quantity should be as great as the patient can endure without much discomfort. I am not sure that it makes much difference in which direction the current be passed. Of its benefit I have no doubt."

All authorities are agreed upon this point. Perhaps there is no affection more generally sent to specialist for treatment; and I doubt if any can be given a more favorable prognosis, if uncomplicated and met with in the early stage.

CHOREA.

When I had charge of the department of nervous disease at the Brooklyn Homœopathic Hospital Dispensary, I had ample opportunity of testing the value of electrization of the spine in this affection. I think almost without exception, my cases all got well without any other treatment.

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[1] Op. Cit., p. 385.

Onimus[1] treats all his cases with an ascending galvanic current, passed along the vertebral column and through the affected limb for thirty to fifty minutes, and reports successes.

Duchenne[2] speaks in the highest terms of the treatment and reports the subjoined cases.

Cases XXV. and XXVI.—"I have submitted to the action of continuous currents of from 30 to 50 elements of my sulphate of lead battery two cases of chorea, in young subjects, aged respectively 14 and 16 years; the current traversing the affected limbs and the vertebral column, in a direction sometimes ascending, and sometimes descending, and each seance having lasted from ten to fifteen minutes. In one of these cases, both the upper and one of the lower limbs were affected by the partial muscular contractions. The patient was cured in fifteen applications; a progressive improvement having been obtained after the first few. The other case, in which the muscular spasms were less general, but of more than a years duration, derived no benefit from the continuous current applied in the same manner."

Case XXVII.—"A young lad had been suffering from chorea for five months. I caused the passage of a descending current from 30 elements of my sulphate of lead battery, during five or six minutes, through each of the limbs agitated by choreic contractions. The hands were placed alternately in a basin of water in relation with the negative pole; and the rheophore of the positive was placed on a point corresponding to the origin of the brachial plexas. After the second application, the agitation of the upper limbs had notably diminished. I then passed a descending current through the lower limbs and (following the direction of the spinal cord) through the trunk, which was the seat of some isolated convulsive contractions. From that time the improvement was progressive, and after fourteen applications the young patient was cured."

Most works on electro-therapy, are full of just such cases; but, as in these, galvanism of the affected parts was made use

[1] Onimus. De l'action des courants continus (*Gaz. des. Hôspital*, Sept. 1869.)

[2] Op. Cit., p. 205.

of as well as galvanism of the spine. True to their faith, the allopaths seem bound to mix their medicines, and think there is no virtue in any prescription that does not contain an adjuvant. In these cases, galvanism of the affected muscles was unnecessary as an auxilliary measure, which Duchenne, had he taken the trouble to try the effect of galvanizing the spine, alone would have discovered.

Backache.

For the want of a better term, I am obliged to use the above, although well aware that the vagueness of the name will be found fault with. Before proceeding any further with the subject, I will define accurately what I mean by the term, or rather on the principle of exclusion will first describe what I do not mean. I do not mean the pain that occurs as a symptom of various spinal diseases, as myelitis, spinal anæmia, or hyperæmia, cervico-occipital, cervico-brachial, intercostal, or other forms of pure neuralgia, nor do I mean the pain symptomatic of fatty disease of the heart, of ovarian or uterine diseases, or that which occurs in malignant diseases of the viscera. The affection I allude to is simply backache and nothing more. We examine the uterus and its appendages and nothing abnormal is found. We carefully percuss and auscultate the lungs, and find them sound: the abdominal viscera are entirely free from disease, the spine is not tender to pressure. In short, as far as human senses can ascertain, the patient is free from any pathological lesion whatever; but the backache remains and is positively the only symptom the patient complains of.

It is both constant and severe, sometimes relieved by the pressure of a tight fitting corset, which the patient is often obliged to wear all night, so excruciating is the agony when the pressure of it is removed. In other cases the reverse of this is true, and the patient can wear nothing tight around the body. The pain is sometimes aggravated by motion, sometimes by rest. Some persons are worse before a storm, others are not affected by the condition of the weather, it is an affection almost exclusively confined to females of the upper classes living in cities, between the ages of 17 and 40, who move in the

best society, who have little to employ either body or mind, who live amidst continual excitement, are quite irregular as to eating and sleeping, constantly violating every law of nature, and in short leading a very artificial sort of life. The pain may occur in any part of the spine, but is most commonly located just above the small of the back. This is what I mean by backache, and if anyone will suggest a better term, I will be happy to discard this one. This disease is a bugbear to the profession. Remedy after remedy is prescribed with little or no benefit, and as a *dernier resort* the patient is sent to the office of the electro-therapeutist. A large proportion of the cases sent to me for treatment are cases of this kind, and I have no doubt that the experience of other specialists is similar. The first impression a physician gets on seeing a patient afflicted with this trouble is, that it is a case of rheumatism. Now I am well convinced that it is not. For in the first place it yields readily to galvanism assiduously used, after a certain method, to be again described, which rheumatism does not. In the second place, it occurs in patients, who show no tendency to rheumatism elsewhere, and who never have had it in any form, and thirdly because when the backache is once removed it does not show the same disposition to return that rheumatism does, nor has it any tendency to metastasis. I have never seen any description of the disease in a medical work. Neftel,* however, reports several cases of backache cured by electricity. The two following cases among the number, which I select as representative types of the ordinary cases we are called upon to treat, and also fairly representing what can be done by electricity in curing such cases.

Case XXVIII.—"Miss G., æt. 23, suffered for years from pain in the middle portion of the back. Her general health was very good, and no affection of any organ could be found. I applied the elongated anode to the painful part of the spine, the broad cathode being placed in the palm of the hand. The intensity of the current was gradually increased to 20 Siem.

* Brown Sequard, *Archives of Scientific and Practical Medicine*, Nos. III., IV. and V., 1873.

elements, and then slowly diminished, carefully avoiding large fluctuations of the current-density by means of a rheostat. Duration of each treatment, six to ten minutes. At the end of five weeks the backache had entirely disappeared."

Case XXIX.—"Miss A. C., æt. 35, principal of a school, extremely anæmic, though her appetite was good and all the functions apparently normal. She consulted me, October, 29, 1870, in regard to her backache, being alarmed by the recent death of her mother and sister from spinal meningitis. I applied to the spine every other day, and with considerable benefit, a weak, perfectly painless induced current. I occasionally tried the electric brush, *but it invariably increased the backache. Even a less painful current, just sufficient, however, to produce muscular contractions, would also aggravate the backache. Having thus satisfied myself that the backache could be favorably influenced only by very weak and scarcely perceptible currents*, I continued this treatment at first every other day, afterwards twice and once a week, and then only occasionally during eight months until the backache entirely disappeared."

The italics here are my own, and refer to the aggravation which is always produced by too strong a current or too prolonged a seance in treating this affection. Indeed, here, as in many other diseases, it is impossible to overestimate, or lay too much stress on absolute necessity of commencing the treatment with the weakest current it is possible to use, and *not increasing it beyond the point at which improvement commences, as long as such improvement continues.* Should, however, the patient not continue to improve, and the tendency towards convalescence flag after a few seances, we may *very cautiously* increase the dose.

Now, although I have already in this work several times repeated this rule, I do not think I owe my readers any apology for so doing, as attention to this point is one of the great secrets of success in electro-therapeutics.

Lumbago.

About half the cases we meet of this disease yield to the faradic current, about a fourth to the galvanic current ex-

ternaly applied, while the remaining fourth require galvano-puncture of the affected muscles to complete the cure. Occasionally we meet with a case that cannot be benefited by any form of electrization, but such cases are exceptional, and probably in these the intervertebral discs are more or less rheumatic, or even there may exist rheumatic arthritis. The duration of the treatment most commonly bears some proportion to the length of time that the disease has existed, and is generally tedious, although some improvement is as a rule apparent after the first seance. Once in a great while, a brilliant cure is made in a very chronic case by one or two treatments, and still more seldom, we find a very recent case which resists weeks of treatment.

Dr. G. V. Poore,* of London, reports the case which here follows:

Case XXX.—"W. G., a brass finisher, æt. 35, was admitted as an out-patient on July 16, 1873." (Charing Cross Hospital.) "He was bent almost double, walked with the greatest difficulty, complained of intense "lumbago pain," and gave the following history:—He had been accustomed to work a good deal with the lathe, standing up and moving the treadle with his right foot. About six years ago a pain came on gradually, affecting the back of the thighs, and hips, which the medical man attending him called sciatica. The pain became so severe that he was obliged to give up work, and has not since been able to resume his employment. The pain left his legs and finally settled in his back; it was most marked in the lower dorsal and lumbar regions, and was of a plunging-shooting character, aggravated by the slightest movement or lightest touch, and implicating not only the dorsal muscles, but the intercostals as well. Movement had become so difficult, that he was often as much as two or three hours in dressing and undressing himself. The back was considerably "bowed," the curoatuae being far more noticeable at night than in the morning. There was no indication whatever of any disease of the vertebra, and the ailment seemed to be mainly muscular.

* Op. Cit., page 174.

The positive pole was placed at the upper part of the spinal column, in the middle line; and the lower part of the back, and the lateral regions of the thorax were thoroughly sponged with the negative pole.

The sponging had the immediate effect of annulling his pain, and produced great redness of the skin of the back and chest. While the current was being used, he was made to exercise his muscles, to flex and extend his back, to rotate his spine, and to inspire rhythmically and repeatedly. The result of this treatment was his rapid improvement and he was soon enabled to resume his employment, which he had discontinued for six years."

As such cases are of every day occurrence and familiar to every busy medical practitioner, it is useless to bore the reader with the history of others, which from their sameness would only be uninteresting.

TETANUS.

The homœopathic relation of electricity to tetanus is a fact that has long ago been unwittingly and unwillingly established by Mattencci. *See page* 24. After experimenting on healthy animals, he makes the discovery that electrization of the spinal cord produces "rigid cramps of all the muscles of the body"—that "the muscles of the trunk and extremities are thrown into convulsions, which last some time after breaking the circuit," and he also admits as the result of his experiments, that frogs, when tetanized by strychnia, were at once restored to their normal condition by a galvanic current, transmitted through the spinal cord. He repeated several times these experiments, as also did Nobili, and always with the same result; but as far as my knowedge of the literature of the subject extends, I believe it was reserved to Dr. Mendel, of Berlin, to first put these facts to clinical use, or at least to be the first to bring the matter to the notice of the profession. Dr. Mendel's first case is reported in the *Berliner Klinische Wochenschrift*, Sept. 21, 1868, and translated by Dr. A. McC. Hamilton of this city in his work on *Clinical Electro-therapeutics*, page 121.

Dr. Hamilton on the following page of the work just quoted

gives the history of an interesting case of idiopathic tetanus, occurring in a little girl, æt. 11, which was cured in ten days by the galvanic current. I here copy it in full:

Case XXXI.—"Commencement of disease on June 15, with trismus. On June 17 contraction of muscles of neck and calf, followed by general tetanus, with greatly exaggerated reflex irritability. High fever; temperature 104.° Eight to twelve elements were employed, the relaxation continuing some time after cessation of the current. After two sittings marked improvement followed, recti-abductor muscles being tense; their relaxation was accomplished by the application of the anode to the second lumbar vertebra, and the cathode to the sternum.

June 23. The interval between the attacks lengthened, and the attacks shortened. Temperature 102.° During the following days the patient continued to improve, with galvanization ten to fifteen minutes in duration.

June 29. Temperature normal; no more tetanic rigidity, and only slight tension of the masseters. Cured." The Doctor in his observation on this case, says: "The direction of the current seems to have no influence on the effect."

Onimus and Legros also report good results in this disease from the use of galvanism.

Spinal Exhaustion.

Under this heading I place the disease generally marked by the following group of symptoms: *General nervousness and irritability. Insomnia, or broken sleep. Feeling of weariness and exhaustion, and utter disinclination to perform labor of any kind.* Easily excited and worried by little things. Intolerant of noise. Heaviness on the chest. Imperfect digestion. Flatulence and pyrosis. Dislike to food. Little appetite. Excess of urea, or phosphates eliminated. *Frequent desire to pass water.* Occasionally *twitching of single muscles*; especially at night. *Frequent attacks of dizziness.* I have in my mind many cases of this kind that were cured by galvanization of the spine. Some of them occurring in men, were put down to the credit of hypochondriasis; and others in women, to hyste-

ria. It occurs most often in young people who grow too fast, or in persons who are in the habit of trying to get four days work into one, and thus expending their vital energies too fast: From the effects of grief and anxiety, etc. Althaus* gives two cases entirely cured by galvanization of the spine.

Progressive Muscular Atrophy, Cruveilhier's Disease.

The pathology of this disease is now generally attributed to some lesion of the grey matter of the antero-lateral columns of the cord. Some of the symptoms correspond with galvanism of the cord, and are frequently relieved by it, but faradization of the affected muscles is also generally required to complete the cure. Dr. Neumann,† of Magdeburg, has published a case of this disease which had proceeded to paralysis of both arms and legs, cured by galvanism of the spine alone.

Spinal Paralysis.

When this affection occurs as a consequence of tumors pressing on the antero-lateral columns of the cord, or follows caries of the vertebra, fractures, dislocations, or absolute destruction of part of the spinal cord itself, no possible benefit can be expected from electricity. But when it happens as a sequel to typhoid fever, scarlatina, or other exhausting disease, we may generally expect a cure from galvanism.

Althaus,[1] Meyer,[2] Hitzig,[3] Tibbitts,[4] and others report several cases.

Progressive Locomotor Ataxia.

Notwithstanding having had a considerable amount of experience in the treatment of this disease, I regret to say, that I have as yet formed no positive opinion regarding the value

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* Op. Cit., page 618.

† *Berliner Klinische Wochenschrift*, Sept. 14., 1868.

[1] Op. Cit., page 517.

[2] *Die Electricität, etc.*, p. 328.

[3] *Virchow's Archives*, 1867. Vol. 60.

[4] *Medical Electricity*, 2d Edition, p. 178.

of electricity in its treatment, as far as the ultimate result is concerned. Many cases, which had seemingly benefited for a time, would get tired of the troublesome treatment, and leave my care to try some other physician, and I of course would hear nothing of the final result. Indeed lack of mental co-ordination or a want of definiteness of purpose is a common symptom of sufferers from this complaint. Others were not at all benefited by any form of current, though the treatment seemed strongly indicated, except so far as the violent pains they suffered from were mitigated.

Hammond in his work already referred to, p. 612, says, that ordinarily electricity did not appear to him to be of any material service; he, however, quotes Meyer, Benedict, Rosenthal, and other authorities, as having reported several cases. Dr. Foot, of Dublin, reports a case, following diphtheria, cured by electrization of the spine, but from his description of the case, and the fact of the disease following diphtheria, I am inclined to look upon his diagnosis with considerable doubt; and to infer that he mistook one of those obscure paralytic affections which commonly follows diphtheria, and which, without any treatment whatever get well of themselves, for progressive locomotor ataxia.

Dr. Poore in his work, merely alludes to the fact that electricity has been used in this disease, and dismisses the subject with a few directions for and cautions in using it. Beard and Rockwell* report some cases benefited, and others that were not at all improved, even by persistent and long continued treatment.

The transmission of a current of electricity from mouth to anus, has been practiced by Aldini and Duchenne, and is a convenient method of bringing all the nervous centres under the influence of the current simultaneously. That it has other advantages, I am unable to say, except the more powerful action on the points where the electrodes are in contact, viz., the rectum and tongue. As the effects of the current on the nerve centres have already been fully entered into, it is unnecessary to further allude to this method of treatment.

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* Op. Cit., p. 530 and seq.

CHAPTER XII.

Direct Electrization of Viscera.

In a previous chapter it was fully pointed out, how internal viscera, as stomach, lungs, heart, liver, intestines, uterus, etc., could be influenced electrically through the medium of the nerves supplying them, and even through the medium of the nerve centre from whence the nerve supplying viscus arises.

As nothing was then said about the *direct* electrization of these organs, we will now proceed to a consideration of it. By direct electrization is understood the transmission of an electric current through the organ or part to be acted upon, either by contact of moistened rheophores with the skin or mucous membrane covering the part, or by the insertion of needles conveying the current into the part.

By indirect electrization we understand galvanism or faradism being made to influence an organ viscus or muscle, by acting upon the nerve supplying such organ viscus or muscle. In many instances direct electrization of a part is to be preferred to indirect, when it is practicable; for instance:

1. When we wish to concentrate the force of current in any one organ or part of any one organ. 2. When the organ to be acted upon is more superficial than the nerve supplying it. 3. When it is desirable to electrize a part without affecting other parts supplied by the same nerve, or the nerve centre itself. 4. When the resistance of the circuit is less directly than indirectly, and for various other reasons, which will be explained when we come to consider each organ separately.

With the exception of the hyperæmia which occurs at the points where the rheophores are in contact, I am unaware of any symptoms being caused or cured by direct electrization, that cannot also be caused or cured by indirect. I must, however, except the uterus and bladder; as from what I have seen (making allowance for resistance, and taking into account only the actual current traversing these organs, at any one given time), I must say that direct electrization seems to have a much greater effect than indirect, and many valuable symp-

toms given at pp. 20 and 21 cannot be caused by indirect electrization in these organs.

What has already been said with regard to the treatment of gastralgia, nausea, vomiting, etc., by electrization of the pneumogastric, applies also to its treatment by direct electrization of the stomach, though these symptoms are not so easily or so quickly controlled aud cured by the current transmitted directly through the stomach, as by the first mentioned method; and though direct electrization of the stomach is practiced by many eminent authorities, it certainly has no advantages over the indirect method, which latter is much more convenient for the operator, and less disagreeable to the patient.

Direct Electrization of the Liver.

Faradization of the liver is a favorite mode of treating every form of so-called bilious derangement by old school physicians, and also by electrical charlatans. When a patient complains of anything they do not quite understand, the unfortunate liver is immediately blamed for being the cause of the disturbance; and if the patient happens to have been through a course of blue pill and colocynth *et hoc genus omne*, without improvement, he immediately is made to submit to several seances of faradization, with a view of increasing the flow of bile! There is really more confusion and uncertainty in this department of electrotherapy than any other, for the very reason that no one has made any attempt to discriminate between the affections that the electric current benefits, and those that are not influenced by it. There is nothing in medical literature that is at all definite enough to be recorded.

In answer to a letter of enquiry on the subject, I have rereceived the following from my friend, Dr. R. N. Tooker, of Chicago, who is well known to the profession as a scientific physician and accurate observer, and whose opinion on anything relating to the use of electricity in medicine I highly value. He says:

"There is a field of practice wherein electricity, I think,

stands unrivalled, and that is, in certain hepatic affections which I am accustomed to regard as due to chronic congestion. I do not know that you meet those cases often in the East, but here they are quite common. Often they have had "ague" and been treated heroically, (quinia and mercury) and are apt to have occasional relapses of ague more or less clearly marked; especially after errors in diet: abuse of coffee, spirits, etc. The subjects are usually fat, flabby, and more or less sallow. They have trouble from indigestion, constipation, and headache. They say they are bilious. The fact is, the liver is torpid and overloaded; its function is not actively performed.

Such cases are ameliorated by Podophyllum, Mercur and China, but according to my experience, are radically cured only by *electricity.*

I think I have never failed in promptly relieving every case of this kind, and curing every case permanently that I have treated for a series of weeks. I have cases in mind that I treated three and four years ago, that have never had a return of their old trouble since I thus treated them."

These few lines really give us more positive information than is to be found in any medical work; and Dr. T. informs me that he is still pursuing experimental investigations in this direction, and hopes at some future time to give the profession the result of his experience.

The pain caused by the passage of gall-stones is said to be relieved by applications of faradism, and the treatment has in the profession many advocates. Hepatalgia, or hepatic neuralgia, may be similarly treated with great benefit.

Direct Electrization of Intestines.

The intestinal canal, besides being amenable to the action of the electric current when transmitted from mouth to anus, or when passed through the splanchnic nerves, can also be affected by rheophores applied to the abdominal walls, or by one rheophore placed on the abdomen and the other in the rectum. Chronic constipation has been treated by faradism very successfully. Althaus, and Beard and Rockwell, speak highly

in its favor, and they, as well as other authorities, report several cases cured, but give no indications for the preference of the current over any drug remedy, or any homœopathic indications therefor. The cases of chronic constipation that I have myself treated, were old standing ones that were not benefited by medication. In nearly every instance they were old persons, mostly women, who had been in the habit of using, or rather abusing drastic purgatives; and had got into such a condition that purgatives would not act. They then tried homœopathic medication, and in that way fell into my hands. In all instances there was atony of the rectum and lower intestines. Some of the cases required long treatment, but all were cured. I regret exceedingly that I can give no characteristic symptoms whereby to select the electric current as *the remedy* except this. Whenever we have a case of chronic constipation in an old woman who has all her life been fond of taking medicine, and that we cannot cure her by the remedies apparently indicated, even when given the extra stimulus of sulphur, let us give faradism a *fair* trial. I do not think it will disappoint us if skillfully used. Dr. Tooker kindly sent me the following report of a case of his:

Case XXXII.—"The patient was a lady, æt. 35, who had been a school-teacher and was naturally of sedentary habits, which tended to produce a most stubborn constipation. To relieve this, she had been accustomed to use injections, and had continued this practice for years. Finally injections utterly failed to move the bowels, and they would go unmoved for two or three weeks at a time.

A digital examination of the rectum showed that its normal tonicity was entirely absent. The rectal walls were loose and flaccid, and gave evidence of having been greatly distended. She had not at this time had a natural, *i. e.*, spontaneous evacuation for several years. I applied the faradic current (negative pole in rectum), full strength, every other day for about a month, effecting a perfect cure. Her bowels moved spontaneously after the third application, and continued regular to this day. It is a year or more since I first saw her.

Colic.

Colic has been treated very successfully by the faradic current, to which it seems to be thoroughly homœopathic, not only as regards the pain, but also as regards the muscular spasm. It is also a favorite form of treatment for old standing cases of prolapsus ani.

Pruritus Ani.

In pruritus ani, one or other form of current will, as far as my experience goes, always effect a cure; most commonly the faradic current is all that is needed, and so prompt and quick is its action that any drug remedy, when compared with it, sinks into insignificance. Practically speaking, indeed, electricity may be said to be the only remedy in this most tormenting trouble.

CHAPTER XIII.

Urinary and Sexual Organs.

Irritable bladder; paralysis of bladder; enuresis nocturna; incontinence of urine from paralyzed sphincter vesicæ; atony of bladder from over distention, as well as that rare trouble, neuralgia of the bladder, have all symptoms that are homœopathically covered by one or other form of electricity, and all are amenable to electrical treatment. Dr. Taylor,[1] of Annerly, records a case of paralysis of the bladder caused by a forceps delivery, cured by faradization after ordinary remedies had failed; and Althaus[2] gives a case of the same affection occurring in consequence of disease of the lumbar portion of the spinal cord, that was much benefited by galvanization.

My own experience with the use of electricity in enuresis nocturna in children and young adults has been very satisfactory. I generally use the faradic current.

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[1] *Lancet*, Febr., 1868.

[2] Op. Cit., p. 664.

Irritable Urethra.

Hyperæsthesia of the whole or any part of the urethra, (as hyperæsthesia elsewhere) whether occurring as a consequence of masturbation (the most common cause) or otherwise, may always be promptly relieved by the use of the galvanic current. The greatest difficulty attendant upon the treatment of this trouble, is the first insertion of the electrode into the highly sensitive canal. Generally the most sensitive portion is about the orifice of the common ejaculatory duct, but in some cases the whole urethral canal from the meatus is in a highly irritable condition. I have treated a great number of these cases, and have been always gratified with the results. A few seances are sufficient to show the benefit of the treatment, and as the hyperæsthesia becomes subdued, the tendency to masturbation becomes less, and the nocturnal emissions of semen, the usual companion of the trouble, less and less frequent. This fact is well known to many spermatorrhœa quacks, and knowledge of it is to them a valuable stock in trade. The utmost caution must be used in galvanizing any portion of the urethra, but a few cells must be used; and even then a high resistance must be introduced into the accessary circuit to prevent electrolysis of the mucous membrane occurring, which would be not only fatal to success, but, needless to add, extremely detrimental to the integrity of the patients' urethral canal.

Impotence.

Impotence from a diminution of the power of erection of the penis, when not caused by a central lesion, is capable of being benefited by faradization locally applied. I have cured two such cases by faradization of the ischio-cavernosus and bulbo-cavernosus muscles. Althaus[1] reports a case of impotence occurring after a gonorrhœa cured in this manner. Duchenne[2] also records a case similarly treated.

Impotence from too great spasmodic contraction of the

[1] Medical Electricity, 669.

[2] De l'électrization localisée, etc., page 764.

muscular fibres of the wall of the common ejaculatory ducts, (to which the name of aspermatism was given by Raubaud) we may fairly presume from the pathogenesis of the galvanic, current on muscular tissue, would be benefited by local galvanic applications. However, I never have been fortunate enough to meet with such a case in my practice. Beard and Rockwell[1] mention having treated two instances with negative results.

Impotence, as a consequence of anæsthesia of the penis, is another condition in which we would expect great good from faradization: especially when the disease depends upon peripheral causes. There is nothing on record, however, at all worthy of being given in illustration. Impotence from neuralgia of the urethra, testicle, or spermatic cord, can (as neuralgia elsewhere) often be remedied by electrical treatment, more especially by the galvanic current.

UTERUS AND APPENDAGES.

Gynæcology, medical and surgical, has been a fruitful field as regards electrical treatment. This department of medical science has done much for electrology; and electrology in its turn has amply repaid the time and attention bestowed upon it. Of course in this part of the work we have only to do with the therapeutic uses of electricity; as I propose devoting another chapter to its many uses in uterine surgery.

Uterine Displacements.

The common displacements of the uterus, ante, retro, and lateral flexions and versions, are usually named as separate diseases, and treated as such in all the text-books we meet with. The unfortunate hyperæmic uterus, is bolstered and propped up by every form of pessary that the ingenuity of man can devise; and in nine cases out of ten, nothing is done to relieve the disease, as the version or flexion is not the disease but the consequence of the disease. The pathological con-

[1] Op. Cit., page 621.

dition which causes the displacement is: (1.) Hyperæmia, which afterwards produces (2.) a blood stasis, or may go on by a (3.) chronic form of inflammation, which in many cases is followed by (4.) a conjunctive hyperplasia. Any of these conditions will produce increased weight and volume of the organ and strain upon the ligaments which are no longer adequate to the task required of them, of holding in position an organ so much heavier than they had been accustomed to bear, and so the uterus falls from its position.

Now it is obvious to the greatest tyro in medicine, that mechanical means for taking the place of the stretched or torn ligaments, and for holding the uterus in position, will not cure the disease, the primary trouble, the hyperæmia. So we have to think of some remedy that in health produces hyperæmia. Now I know of no remedy that will produce local hyperæmia that at all compares with electricity. The faradic current is all we need, unless the disease has gone on to hypertrophy or hyperplasia. Hear what Tripier[1] says:—

"General faradization of any part of the body causes a hyperæmia, which is limited as to its duration, to the time during which the currents of induction are continued."

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"The object of the operation is to *cause* a transient hyperæmia, which *cures* soonest and with most certainty, stasis and even congestion." In the same article from which these lines are taken, he goes on to describe the operation of faradizing the uterus, and says, in cases of retroflexion, he introduces one pole of the battery into the bladder, and the other into the cervix uteri; and in cases of anteflexion, one into the rectum and the other into the cervix, and allows a strong current to flow until bearing down pains are felt. He extols the treatment, and speaks of the results he obtains in the highest terms. I have no doubt Dr. Tripier does get good results, and cures the majority of his cases by this method. But is it necessary to produce the bearing down pain and to faradize the sensitive

[1] Disorders of Nutrition and Displacement of the womb. Archiv. Neurology and Electrology, Vol. I, page 148.

bladder in these cases? I think not—I would call it very crude homœopathy. In my practice, I get the best possible results, by concentrating the action of the current in the womb itself, transmitting the current (generally the faradic) from the fundus internally to the os, making applications with a mild current daily, or at the farthest every other day, until the uterus comes down to about its normal internal measurement. The operation is painless in this way, and though not always so easy to the operator as Tripier's method, is, I believe, the correct mode of treatment. I have treated a great number of cases in this way, and have never found any that were not benefited. It is true that in some cases of great hyperplasia, I was obliged to use a temporary support for the uterus, until the hypertrophy and prolapse diminished sufficiently to trust the weakened ligaments with the weight of the womb. Recent cases are quickly cured. Old standing ones take a *long* time.

DYSMENORRHŒA.

Without touching upon the many views of the pathology of this affection, and the number of theories that have from time to time been laid before the profession respecting it, I would first draw the attention of my readers to the symptoms produced upon the uterus by electricity, page 29, and ask them to compare these symptoms with those of any ordinary case of the difficulty that they may have met with in their practice; and also to compare them with the case below given, reported by Dr. Neftel[1] of this city. And having considered carefully the facts of the case, I would ask whether I am right in attributing the cause to HOMŒOPATHY.

Case XXXIII.—Miss E., æt. 29, has inherited a neuropathic constitution; her father having died from softening of the brain. She always suffered from dysmenorrhœa, and though well nourished and looking tolerably healthy, was frequently subject to headaches, flushed very readily, and often had fainting fits, especially during the menstrual pains. The dysmenorrhœa was always accompanied with a sensation of cold in the

[1] *Medical Record*, Oct. 6th, 1877.

extremities, with congestion to the head and other vaso-motor phenomena. Dr. Sims found anteflexion of the uterus, and proposed an operation (incision of the cervix), as nothing else could relieve her dysmenorrhœa. She was afraid of an operation and therefore Dr. Sims kindly referred her to me for galvanic treatment, October 23d, 1874. As all the usual remedies had been tried without benefit for so many years, I concluded to observe the effect of the galvanic treatment, unsupported by any other medication, in order to obtain and demonstrate the uncomplicated result of the galvanic treatment of dysmenorrhœa. In the progress of this case there was nothing of particular interest which would require any special notice. Under the influence of daily galvanic treatments, the menstruation appeared November 5th, with considerable pain, which, however, lasted only a few hours. The next menstruations (December 5th and 31st), were entirely painless. Moreover, she was relieved from the headaches, fainting fits, coldness of the extremities and other morbid symptoms within the vaso-motor sphere, and left New York, January 12th, 1875, in a perfectly healthy condition, which still continues. Last fall on her way from the Centennial Exhibition, she visited New York, and called on Dr. Sims, whom she informed that she is permanently cured of the dysmenorrhœa and other morbid symptoms by the galvanic treatment. Dr. Sims, referring to this case in a note to me, writes: "On examination I found the uterus of the same shape and size, and with the same relations as when I saw her before the galvanic treatment). But there was no congestion of the cervical mucous membrane as before."

This examination proves beyond any possibility of doubt, that the dysmenorrhœa, which lasted in our patient from the first appearance of catamenia, over fifteen years, and could be ascribed to the existing structural disorder of the uterus, has been permanently cured by means of the galvanic current, notwithstanding the persistency of the organic affections. The circumstance that a congestion of the cervix was not noticed [illegible] after the galvanic treatment, can evidently be [illegible] consideration. Such congestion of the cervix must [illegible] result of dysmenorrhœa, rather than to its

Cases of this affection are also reported by Beard and Rockwell,[1] cured in a similar manner. I believe that in our Materia Medica we possess no remedy that can at all compare with electricity in this painful trouble. Faradism will sometimes cure when galvanism fails, and *vice versa*; it is impossible to tell before hand which form of current is required any more than we can always with certainty prescribe the exact dilution of a drug remedy.

AMENORRHŒA.

This is a symptom of the secondary effect of the current, and either form of current is a valuable remedy, in some cases the menses often reappearing after one or two seances. Dr. Golding Bird[2] says, that he believes electricity is the only effectual emmenagogue we have. In the allopathic school it is indeed now becoming routine practice to treat every case of cessation of menstrual flow with electricity, (with all due respect to that fraternity of course I except pregnancy). Duchenne, Althaus, Schultz, Bairlacher, Sir James Simpson, and a great number of other electro-therapeutists, and gynæcologists record numbers of cases cured by this remedy.

In our school we are apt to be more discriminating, and we treat absence of the menstrual flow, not as a disease, but merely as a symptom, and writing, as I do, exclusively for homœopaths, I need not here say, that it is not wise to treat every case of non-appearance of the menstrual discharge by electricity; indeed, I would be sorry to advocate any such treatment. For we may have stoppage of the menses from mechanical retention, or we may have emansio mensium from abscence of uterus or ovaries, and a number of other conditions in which we could not possibly expect any good result from electricity.

Briefly summed up: my experience in the treatment of the affection is this, that where this symptom exists in any disease, and the other symptoms of that disease correspond with those produced by either form of electrical current, then the case is

[1] Op. Cit., p. 597.

[2] Lectures on Electricity and Galvanism, *London Med. Gazette*, 1847, p. 705.

one for electrical treatment, and I feel certain I am not saying or claiming too much for it when I say, that when properly used, according to the method hereafter given, that it will seldom disappoint us. I have treated a great many cases of chlorosis, anæmia, tendency to obesity, etc., where this symptom was the prominent feature, and if my recollection serves me aright, have had so far only two failures.

As this goes to the press, I have the following from Dr. Tooker, of Chicago:

"In amenorrhœa I regard faradism as nearly specific. I have treated successfully a number of young ladies in whom the menstrual function had never been regularly established. In one case the patient was 19. First menses had appeared when she was 14. During five years she menstruated but eleven times. Was subject to 'nervous spells;' would get numb at times. Abdomen distended and hard. Uterus somewhat congested but otherwise normal. A few applications of electricity established the menses and she has been regular ever since (about eight months)."

Menorrhagia.

As will be seen from the pathogenesis, this symptom is one of the primary effects of the current, and must also be considered as a single symptom, and not as a disease *per se*. It occurs as a consequence of a variety of pathological conditions, I of course limit the meaning of the term to profuse menstrual flow, which may be too often and too profuse, or regular as to time but the quantity too great, or too frequent but the quantity normal, in which latter case, the quantity excreted during the month is in excess of the normal amount. I do not include metrorrhagia from any cause.

When the ordinary drug remedies fail to act and other indications point out the electrical pathogenesis, let us think of electricity as the remedy; and not only think of it, but have it employed.

Case XXXIV.—The most aggravated case of the trouble I ever saw, was that of a lady, æt., 32, who came to me

about a year and a half ago, to be treated. She was feeble, pale and emaciated, and had œdema of hands and feet. She gave me the following history:—About two years ago she had her last child, and three or four months after that she began to menstruate with considerable pain, the flow lasting at first five or six days, and very profuse. Each menses was more copious, and lasted longer than the preceding one, up to the time I saw her; at which time not more than three or four days elapsed between the periods. A physical examination revealed the following condition of things. Paleness of vagina. Retroversion of the uterus, *which measures* 4½ *inches in length*, internal measurement. Was soft and spongy to the feel, but perfectly movable. A pale sanguinolent discharge oozing from os. She had been through a number of allopathic hands, and had been scarified, cupped, leeched, blistered, and dosed *secundum artem*, without any benefit; but she seemed to think, was made worse. I commenced treating her at once with a mild faradic current, internally applied, which I used daily. The result was that during the first month of the treatment, she menstruated three times, during the second month twice, during third month twice, which lasted only five days; three times during the next two months, at the end of which time the measurement of the uterus has decreased by one inch, and was harder and firmer. She continued steadily to improve, and I reduced the frequency of the applications gradually to once a week, continuing them for a year, at the end of which time the menses were nearly normal, that is to say about every twenty-six or twenty-seven days, about the proper quantity, and occurred with very little pain. The measurement of the uterus was also about normal, so I discontinued the treatment, perfectly satisfied with the result. She is now a healthy, robust looking woman, some twenty-five pounds heavier than when she came under my care, and is about three months pregnant; all of which (except the last) I must attribute to the treatment, as the only other remedy she used, that had any bearing on her condition, was Crotalus[6], which I prescribed for her when she was nine months under my charge, for a number of echymosed looking spots on the skin, which by the way it cured very effectually.

Catarrh of the Uterus.

Chronic cervico-metritis, and even endo-metritis is susceptible of being entirely cured by the galvanic current alone, and unaided by any drug remedy. For this disease I use a few cells of large quantity, and do not repeat the applications oftener than twice a week, using the negative pole directly in contact with the diseased surface which in the cervix at least should be first cleansed thoroughly. I have treated over twenty cases in this manner, and in all the result was very satisfactory. Erosions and ulcers may be treated in a like manner.

Vaginismus.

It is not unreasonable to expect that this trouble, as hyperæsthesia in other parts, would be benefited by the galvanic current. I treated one very aggravated case with decided benefit, but the patient got tired of the treatment (five seances) before I had time to thoroughly test the remedy.

Pruritus.

Purulent and follicular vulvitus have both this characteristic symptom, which, indeed, generally the only thing the patient afflicted with either of these diseases complains of. It also occurs from herpetic eczematous eruptions, from simple hyperæsthesia of the mucous membrane, and from a variety of other causes. When it occurs from hyperæsthesia, which is common in very nervous women, it yields readily to either form of electric current. When it exists as a consequence of the other diseases mentioned, galvanism is the form of current from which most good may be expected.

Vaginal Catarrh.

Chronic muco-purulent vaginal leucorrhœa, I can positively assert gets *well* quicker when treated by the galvanic current than under the influence of any other remedy. Indeed, I have

never yet seen any case of this affection positively and entirely *cured* by any internal medication. In treating it by electricity, it is necessary to have a vaginal rheophore that will not only fill, but also slightly distend the vaginal canal. Either pole will benefit—negative seems to give the best and quickest results.

CHAPTER XIV.

SKIN DISEASES.

Many skin diseases are attended by hyperæmia and by hyperæsthesia, increase of temperature of the part, pain and itching.

Now we have already seen the power of the action of electricity in causing and curing these symptoms when occurring in other parts, and we have also seen, by the pathogenesis, that the electric current causes these symptoms on the skin; it now remains to show that it cures them.

Erythema.

Dr. Lilienthal,[1] in his excellent work on "Diseases of the Skin," says: "Erythema, being a mere *hyperæmia of the skin*, makes itself objectively known by *redness* and *swelling* of the skin, *the temperature of which is somewhat increased*, and subjectively, sometimes, by a sensation of *burning* and *itching*." (The italics are mine). I have already elsewhere[2] reported a case of erythema fugax of the neck and chest entirely cured by the use of the galvanic current. None of the authorities on electro-therapy, however, make any mention of this disease in their treatises.

Urticaria.

Not only the prominent symptoms of this eruption, but as far as human senses can discern, the actual disease itself is produced by the galvanic current, as before mentioned in the pathogenesis. Indeed it often appears in patients being treated even with the very mildest currents, after one or two seances. I have had but little experience in the treatment of it by electricity, as the cases I have had, generally yielded to appropriate dieting and internal remedies; but should I ever have

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[1] Page 11.

[2] *Medical Union*, November, 1874.

a case resist ordinary medication, I would not hesitate to rely on some form of electrical treatment for its cure.

Herpes.

Here we have another eruption, the symptoms of which are produced in totality by galvanism and are curable by the same agent. I recently reported at the County Society a case of a tumor of the breast treated by electrolysis (three treatments), and after each treatment there appeared fresh patches of a herpetic eruption on the face and neck. To exemplify the curative effects the case below given is reported by Dr. A. McLane Hamilton, in his "Clinical Electro-therapeutics."

Case XXXV.—"*Herpes Zoster associated with Intercostal Neuralgia.*—M. C., æt. 25. The patient had been affected for some time with a vesicular eruption on the right side, beginning in the groin and arching over the crest of the ilium, extending as far back as the vertebral column. Two successive patches had appeared, and he was so tortured with neuralgic pains as to lose all rest. I applied a metallic electrode (negative) to the eruption itself, and the positive pole over the lumbar vertebræ. The pain disappeared in two or three minutes; and, when I next saw him (a week afterward), the eruption had completely dried up."

In a work entitled "Clinical Researches in Electro-Surgery," by Beard and Rockwell, the authors report cases of herpes-zoster and herpes-frontalis successfully treated by applications of galvanism.

Eczema.

This affection is more intractable to ordinary medication than any of the preceding, and consequently a greater number of cases of it fall to the lot of electro-therapeutists. There is, therefore, no lack of information of the effects of electricity in its treatment. As we have already seen, most of its prominent symptoms, both objective and subjective, are caused by galvanism. Drs. Beard and Rockwell, in their work last quoted, record three cases of the disease cured by galvanism of the nervous centres, and remark, that the result of their

experience is, that eczema yields to galvanic treatment and gives better and more satisfactory results than any other form of cutaneous disorder.[1]

One of their cases I here copy:

Case XXXVI.—"John B., æt. 3 months, was admitted to the Demilt Dispensary, March 8th, 1872. The child was affected with eczema of the scalp and face, which was most marked between the eyes, and extended down the back, and on the legs from the knees to the feet.

The eruption was very moist, and the diseased part was covered with thick yellow scabs. The child was very restless at night; was very constipated, and could scarcely open its eyes. The case had been treated by various poultices and ointments. At the time we were experimenting with central galvanization in diseases of the skin, and we resolved to test the method in this case. After the third application the bowels became more free, the child slept well, and the eruption had dried up, and the scabs peeled off. At the end of two weeks the fourth and last application was given; the disease had then nearly disappeared from the back and legs. Since that time we have seen nothing of the patient."

Dr. E. L. Mann,[2] of Brooklyn, has published in the *Medical Record* several cures of eczema made by galvanization: one case of which only required four seances; the length of his applications is fifteen minutes, and he generally repeats them about twice a week. I must confess I have never seen any case yield in so short a time; and cannot think that either Dr. Beard's or Dr. Mann's cases represent the average we meet with.

Prurigo.

This tormenting affliction yields readily to any form of electric current. I reported some time ago some cases cured.[3] Tibbits, Althaus, and other authors allude to it as being very amenable to galvanic treatment.

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[1] Page 49.

[2] *Medical Record*, October 1, 1872.

[3] *Medical Union*, November, 1874.

Acne.

This most rebellious skin eruption often disappears under a judicious use of one or other form of current, but often on the contrary it will not. I had a case of acne-simplex of the face, last winter, occurring in a young lady, who was very anxious to have it cured, and gave me every opportunity to do so if I could; but after using galvanism and faradism for two months without benefit, both patient and physician became discouraged. I sent her to my friend, Dr. Lilienthal, who cured her with a few doses of *Natrum mur.*[200].

It is impossible, in the present state of the science of electrotherapy, to discriminate between the cases of this disease as to the applicability of the remedy. We may have five cases of *acne faciei*, all possessing seemingly the same symptoms, and three of them will get well under electrization, while the remaining two will not. Why? is a question for future discovery.

Dr. W. B. Cheadle[1] has given the profession a valuable paper on acne rosacea, in which he reports three cases almost cured, and one improved, and still under treatment. He used the faradic current in all his cases. Other skin affections have been treated by electrization by Beard and Rockwell, who report favorably of the affects of the current in lichen, psoriasis, pityriasis, and alopecia.

From what is here set forth, I feel certain that every physician among my readers will value electricity as an important addition to our other remedies, in the treatment of skin diseases, and though the proving is meagre, and the absolute indications are not clear in every instance, I hope I have shown conclusively, that at least it *does* cure according to the law of similars.

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[1] *Practitioner*, July, 1874.

CHAPTER XV.

NEURALGIA.

The culpable looseness with which the term neuralgia has been used of late years, both by the profession and the public generally, has led to much confusion in this department of medical science. The word is unfortunately made an equivalent oftentimes for any kind of pain, the pathology of which we may be ignorant. The pains of rheumatism, gout, syphilis, locomotor ataxy, spinal irritation, myalgia, etc., are often mistaken for, and confounded with true neuralgia, even by those who ought to know better. For these reasons I may be pardoned, if I here define what I mean by the heading. There is no term which describes the disease so well as that used by Hammond:—*Neural Hyperœsthesia.*

It is indeed a hyperæsthetic condition, sometimes involving the whole course of a nerve, from its origin to its ultimate ramifications, at others only affecting a small portion, either of the trunk of the nerve, or one of the fibrillary terminations. The pathological condition causing this hyperæsthesia may be, as Anstie* says, "*atrophy of the posterior root of the spinal nerve in which the pain is felt,*" (which, I feel certain, it often is), or a lesion of nerve trunk itself, or otherwise.

The essential characteristics of this condition are:

1. Pain, which in intense acuteness is out of all proportion to the constitutional disturbance, is intermitting, or at least remitting in character.

2. Severely tender points at different places along the affected nerve, and corresponding to the spots where the nerve enters, or emerges from a fascia, bone or muscle; with often anæsthesia or partial anæsthesia between these points.

3. Secondary phenomena; motor, vaso-motor, secretory or trophic. The special symptoms varying according to the location of the nerve and parts supplied by it.

That transmissions of a strong electric current produce a

* Neuralgia and its counterfeits, page 110.

condition analogous to neuralgia, we have already proved, page 22.

Duchenne,* speaking of faradizing the terminal branches of nerves, says:—"Consecutive to the treatment, some of the patients experienced deep-seated pains in the course of the nerves, the extremities of which had been excited, pains that have frequently been persistent and have assumed the character of neuralgia;" and again,† in speaking of the differential action of the current, says:—"These experiments are not harmless; because in many cases the acute sensations have been followed by neuralgic pains in the organs ever excited." In every work on electro-therapy we find the treatment of neuralgia more dwelt upon than of any other disease, except paralysis; and it is in this affection that electricity, as a remedy, has earned most of its laurels. I here quote the opinions of a number of eminent authorities. Anstie‡ remarks, "The constant current, as I now estimate it, is a remedy for neuralgia unapproached in power by any other, save only blistering and hypodermic morphia, and even the latter is often surpassed by it in permanence of effect; while it is also applicable in not a few cases where blistering would be useless or worse." Althaus[1] lays down, as a rule, "That in the milder cases of hyperæsthesia all the different forms of electricity may be usefully employed, but in the severe forms of it only the continuous current affords relief." Hammond's opinion is, "Above all local means, not only for relieving the pain of any particular paroxysm, but also for effecting a permanent cure, electricity stands first. I have employed it in every possible form, and am satisfied that the primary galvanic current is the preferable agent." Beard and Rockwell[2] express their estimation of the remedy in the following language: "The success achieved by electrization in the treatment of neuralgia has been brilliant and remarkable." Dr. G. V. Poore[3] speaks very

* Localized electrization, page 125.
† Page 35.
‡ Neuralgia and its counterfeits, page 200.
[1] Op. cit., page 600.
[2] Op. cit., page 471.
[3] Electricity in Medicine and Surgery, page 162.

highly of the excellent results he gets from electricity, and says, "There are many cases of neuralgia on record, which have resisted every known method of treatment, but have yielded after a few applications of the galvanic current." Erb[1] says, "Electricity, and especially the galvanic current, has been found to yield the most gratifying results in the so-called idiopathic neuralgia, in most of those which are due to a rheumatic or neuritic process, and which have become habitual, and finally in a certain proportion of eccentric neuralgia. Indeed the results are sometimes astonishing, so quickly do they appear. In other cases, however, it is necessary to persevere in this mode of treatment for a long time, and with great regularity, before a cure is effected." In the works of Meyer, Rosenthal, Benedict, Tibbits and others, we have the most uncontradictable evidence brought to bear on this subject; and the cases recorded by these eminent physicians permanently cured by electricity, can be counted by the hundreds. Most of these authorities, however, admit two great secrets of success.

1. The whole of the trunk of the affected nerve must be included in the circuit.

2. *Regularity* of applications, which in all cases ought to be *repeated at least* daily.

These conditions being strictly observed, it matters little whether the current be transmitted in an ascending or descending direction, that is to say, whether we use a direct or inverse current, or whether we produce the so-called electrotonus or anelectrotonus of the affected nerve.

All the facts that we can possibly demonstrate, are, that a strong current of electricity, transmitted through a nerve in any direction, causes a condition similar to neuralgia, and a weak current will cure neuralgia when occurring idiopathically. It will be noticed that most of the authorities quoted, lay great stress on the use of the galvanic current, and either entirely ignore or deprecate the use of the faradic. Now it appears to me, that the reason of this must be that those phy-

[1] Diseases of the Nervous System, page 80.

sicians, in endeavoring to produce an effect on the hyperæsthetic nerve, transmit a current of too great intensity through it, which it will in no instance tolerate without the most excruciating aggravations being produced. They do not seem to calculate, or they seem to have lost sight of the fact, that the faradic current, though shorn of its chemical effects and diminished in quantity, is infinitely more intense in its dynamic action than the primary force generating it, and, as we before remarked, the longer and finer the wire used in the induction coil, the more intense the current, though more reduced in quantity, just as with the high potencies of our drug remedies. In my own practice I have observed the following:

1. That whatever form of current be used, only the very mildest intensities are curative.

2. That a large percentage of cases are curable by strict attention to this rule.

3. That high intensities of either form of current produce serious aggravations.

4. That a certain proportion of cases yield to the galvanic current, that cannot be cured by the faradic, and *vice versa.*

5. That it is impossible always to tell beforehand, which form of electricity will cure any given case, any more than we can always tell which potency of a drug remedy is the proper one to use.

6. That there are undoubtedly a small proportion of cases that will yield to neither forms of current administered alone, that will rapidly improve under a judicious alternation of the forms.

7. That the number of cases which entirely resist every form of electrical treatment are very small indeed.

8. That where the nerve is deeply seated, electro-puncture of the sheath, or even of the nerve itself, becomes necessary, as otherwise recomposition takes place in the more superficial structures, without the current reaching the nerve at all. This operation must be performed by a thorough expert in electro-therapeutics, as without the greatest skill being exhibited, electrolysis of the nerve takes place, which is not only fatal to success, but disastrous in its consequences.

9. A Brenner's rheostat should always be used in the circuit; also a galvanometer; for obvious reasons.

Among a number of cases reported by Althaus,* there is one which is so very remarkable and instructive, that notwithstanding its length, I here copy in full, as it would be impossible to omit any part of the report, without detracting from its value.

Case XXXVII.—"The patient was a huntsman, æt. 64, accustomed to live in the open air and to 'rough it.' Five years before he came under Professor Niemeyer's care, he first felt a 'painless shock' through the left side of the head and face; and such shocks returned at frequent intervals. After this had gone on for a twelvemonth, attacks of severe pain came on, which commenced at the angle of the left jaw and proceeded through the zygomatic arch right into the skull. Such attacks occurred at first about once in three weeks, and were generally owing to some exciting cause, such as smoking, masticating, speaking, wiping the mouth, etc. Pressure neither increased or diminished the pain, the fits of which gradually became more frequent. The shocks lasted only one or two seconds, but recurred twenty or thirty times in the course of the day in the third year of the disease. In 1864 the patient consulted Professor Billroth, of Zurich, with the view of undergoing a surgical operation. The pain at that time never came on without touching or moving the left side of the face, nor did it occur during sleep; it affected the left cheek, the upper lip, the upper jaw, and the teeth. A few decayed teeth were extracted, but this gave no relief whatever. A number of remedies, such as quinine, iron, arsenic, iodine and veratrine, were then given, with the same result; and only subcutaneous injections of morphine produced temporary benefit. By the advice of the late Professor Griesinger, four leeches were put to the diseased side; and this was repeated a week after, but the condition of the patient remained exactly the same. Professor Billroth then excised a piece of the infra-orbital nerve, one and a quarter inch long, from the infra-

* Medical Electricity, page 603, et seq.

orbital canal. The piece of nerve which had been excised was carefully examined with the microscope, but was found to be perfectly healthy. The patient only remained free from pain a few days, after which the attacks reappeared, although not quite so frequently, nor so severely. At that time the attacks were brought on by pressure on the left upper jaw, and the parts animated by the infraorbital nerve remained free from pain. The paroxysms, however, getting continually worse, Professor Griesinger advised the removal of the painful parts of the alveolar process of the jaw by means of raspatories. The patient was not put under the influence of chloroform for this operation, as he had to state which parts of the bone were tender. The operation was excessively painful, but had a favorable result; the patient was discharged on May 27th, 1864, being then apparently quite well. He came back in February, 1866, and reported that for some time he had been quite easy, but that the attacks soon returned and gradually became more frequent and severe. He urgently demanded a radical operation. The left cheek was now free from pain, but all the other parts, which are animated by the second branch of the fifth nerve, were affected. Professor Billroth then performed osteoplastic resection of the upper jaw, as proposed by Professor Langenbeck. He broke off the posterior wall of the antrum, and the posterior part of the lower portion of the orbit, dissected away the second branch of the fifth nerve up to the foramen ovale, and divided the nerve close to the foramen rotundum. The zygomatic and superior alveolar branches were then drawn out as far as possible and likewise removed, and the infraorbital nerve was entirely taken away. The operation was not followed by any bad symptoms, and the wound of the jaw healed well together. A careful microscopic examination of the excised piece of the nerve again showed no alteration whatever. This operation did good for a time, but towards the end of March, of the same year, fresh paroxysms of pain occurred on touching the left upper lip. They soon became so severe, that Professor Billroth excised on April 6th, 1866, the buccinatorius nerve, which branches off from the third ramus of the fifth. This operation was

rendered difficult by the numerous cicatrices consequent upon previous operations; the ductus stenonianus was injured close to its point of exit from the gland, and erysipelas set in afterwards, but yielded to treatment. The pain was now quite gone, but a salivary fistula remained. In May the tic was again as bad as ever in the left side of the palate and chin. On May 9th, therefore, Professor Billroth cut away from the cavum oris through the lateral wall of the antrum, in order to excise the posterior dental nerves, and resected at the same time the mental nerve at its exit from the inframaxillary canal. On May 21st salivary fistula was operated for, the anterior portion of the gland being removed, and the skin united by sutures. The parts did not heal, but suppuration set in, and the whole gland gradually sloughed away. In July, 1866, the patient left the hospital free from pain, and also cured of the fistula.

He did not, however, long continue in good condition. In December, 1866, the attacks were again very frequent. He was re-admitted in July, 1867, when the pain was excessively severe; it then proceeded from the dental process of the upper jaw, and radiated towards the nose, the lower eyelid, ear, and temple, from where it penetrated into the cavity of the skull. Professor Billroth then advised the use of the constant current; but as the patient believed that he could only be cured by a surgical operation, the professor, on the urgent entreaties of the poor man to do something for him, tied the left common carotid artery, just below the omohyoid muscle. During the first few days after this operation, a few feeble shoots of pain came on, but they soon ceased, and on the 17th day the patient left the hospital apparently well. But again the improvement was only temporary, and as Professor Billroth had, in the mean time, left Zurich for Vienna, the patient went to Tübingen, to consult Professor Niemeyer concerning the applicability of galvanism.

He was admitted into the hospital in December, 1867. At that time he used every day eight grains of morphia for subcutaneous injections, this being divided into three doses. Fits of pain came on twenty or thirty times during the day; their start-

ing point being the maxillary articulation, whence they spread to the anterior side of the ear, and the left parietal bone. They came on chiefly on touching the left upper lip. The constant current was now used, and with such beneficial effect, that the patient was soon enabled to discontinue the subcutaneous injection of morphine. After three months' treatment, the current having been applied nearly every day, the patient left the hospital apparently cured. Whether the effect of galvanism will be more permanent than that of the surgical operations, remains to be seen; but if a relapse should occur, the same remedy would probably produce the same effect. The current was applied by moistened electrodes to the affected nerves, no regard being had to the direction of the current, and for five minutes at a time; sometimes both electrodes were directed to the skin, at other times one was directed to the skin and the other to the mucous membrane of the mouth."

If the use of electricity was even entirely confined to the saving of such terrible butchery as this, (I can call it nothing else), would it not even then be a boon to suffering humanity? There is no doubt in my mind, that if this unfortunate sufferer had been treated at the outset by galvanism, that the cure would have been a brilliant one. Although in our school, of course, no such wholesale nerve-slaughter would have been thought of, I doubt if any known remedy in our Materia Medica would, in a case of this kind, give even a tithe of the relief of the galvanic current properly used. This case is given to show the decided advantage of electricity in such cases over surgery; and in order to demonstrate its superiority over ordinary medical treatment, I quote the following case, reported by the same physician.*

Case XXXVIII.—"The patient, æt. 74, at the time he came under treatment, had been already a sufferer from the neuralgia for twenty-nine years. In this case a host of external and internal remedies had been used without effect. M. Nélaton had refused to perform an operation, and so had Professor Bruns, of Tübingen. The induced current had been used as

* *Berliner Klinische Wochenschrift*, No. 77, 1868.

an 'electric moxa,' but without producing any benefit. In July, 1867, Professor Niemeyer used the constant current, connecting the positive pole with a moistened conductor, and the negative with a wire brush. After twenty such applications the pain was gone, and only a slight increase of sensibility remained in the upper lip. Some months afterwards there was a relapse, but this yielded rapidly to galvanism."

Althaus* relates one case of facial neuralgia cured by the faradic current, after bleeding, blistering, purging and dosing had entirely failed; all of which, he says, were given a *fair* (?) trial.

Anstie† mentions a case, treated by Dr. Russell Reynolds, of a lady who had been the victim for twenty years of an extremely severe neuralgia of the ophthalmic division of the fifth nerve, which attacked her *daily*, and had caused great injury to her general health and nutrition, was not merely benefitted, but absolutely removed, at any rate for a long period by a single application of the galvanic current.

Cervico-occipital Neuralgia.

I mention this form of neuralgia as it is given under Valleix' classification. All authorities admit that neuralgia occurring in this location (that is, in the first four cervical nerves), seldom remains stationary, or limited to these parts, but shows a disposition to extend itself either toward the lower parts of the face, in which case it often becomes extremely difficult to distinguish it from neuralgia of the third division of the trigeminus; or towards the lower cervical and first dorsal nerves, in which case it merges into cervico-brachial or dorso-intercostal neuralgia; and the pains are felt in shoulder, arm, mammary gland, scapular region, and at any one or all the parts supplied by these nerves. Cervico-occipital neuralgia therefore being such a very rare disease, I here include under the same heading, cervico-brachial and dorso-intercostal neuralgias. In treating this form of disease, aggravations are very easily pro-

* Op. cit., page 601.

† Neuralgia and its counterfeits, page 208.

duced; in illustration of which the accompanying case is quoted.*

Case XXXIX.—"Mrs. A. F., æt. 35, a woman of small stature, graceful in form, and of a lively temperament, the mother of several children, had been suffering for the last seven years, with a considerable degree, of anæmia. On January 9th, 1856, while present at an evening company, she caught a cold, which brought a severe griping pain in the left ear and shoulder. Her domestic affairs having at the same time called forth unusual exertions, this and a perturbed emotional condition excited, about January 16th, a feverish state, united with palpitation of the heart, labored breathing, and tearing pains in various parts of the body. A light anti-phlogistic treatment, continued for fourteen days, removed all these symptoms except the pain in the limbs, which harrassed the patient more especially at night; these after a while concentrated in the left shoulder, extending thence into the left ear and soon attacked the third branch of the trigeminus. On the 28th of January, the pains thus located, attacked her in a new and peculiar manner; the pain in the face came on like a flash, lasted from five to ten minutes, and then as quickly passed off. At first these attacks recurred after intervals of considerable length, afterward they visited her daily about ten o'clock in the evening, but always lasted but a few minutes; gradually they increased in frequency, intensity and duration, being at least repeated five or six times a day, when they included also the other branches of the trigeminus, and robbed the patient of rest at night for whole weeks. Quinine, arsenic, a tonic diet, the removal as far as possible of all causes of excitement, a salve of Veratrum—all were tried with none or at most with doubtful effect, and the patient consequently upon the advice of Drs. Phillip and Friedländer, applied to me May 3d, 1856, for a trial of electrical treatment. *After the first sitting a marked exacerbation of the pains occurred; they raged for more than fourteen hours with a fearful intensity;* they then, however, underwent a marked subsidence, and after two appli-

* Medical Electricity—Moritz Meyer, page 314.

cations, repeated on the 5th and 9th, with *weaker currents*, the neuralgic pain completely and permanently disappeared."

A case very similar to this was sent to me for treatment some years ago by my friend, Dr. Searle, of Brooklyn, who, previous to applying to him, had been under the tender mercy of several allopaths, who cupped, leached, and applied the actual cautery, without benefit. After two treatments with the galvanic current he was very much relieved, and after thirteen daily seances entirely cured and has remained so ever since.

When neuralgia attacks the dorso-intercostal nerves, the length of the treatment necessary is generally much greater than that required in any other location. The seances must be more frequent (about twice a day), and each intercostal nerve treated separately. The following of these directions requires the sacrifice of much time, and demands precision in attending to the carrying out of the tedious details on the part of the physician, and considerable patience and perseverance on the part of the patient. However, even with all its drawbacks, electricity will cure intercostal neuralgia quicker than any other remedy that I know of. I here speak of the average cases we meet with, for occasionally, as with other diseases, we may hit upon a brilliant success with a few short seances. In my own practice, I only met with one case that yielded to less than two or three weeks persevering treatment, and that was a case occuring in a young man sent to me by my friend, Dr. Wm. T. Helmuth, last winter, who was relieved in three treatments.

An error in diagnosis may often lead us to imagine that we make a cure; for instance, it is quite possible to confound a case of myalgia—those wandering muscular pains occuring in this vicinity—which a single seance of faradization will generally speedily ameliorate, for a case of true neuralgia.

Sciatica.

Next after the trigeminus, the great sciatic nerve is the one perhaps most commonly attacked by neuralgia. It has been treated successfully by several methods.

1. By external galvanization or faradization, the moistened sponge rheophores, being applied one on the skin to a point

where the nerve emerges from the sciatic notch, and the other to a point of the nerve lower down.

2. By one electrode placed within the rectum as near as possible to the point of origin of the nerve (as recommended by Duchenne and largely used by Benedict), and the other on the skin over the sciatic notch.

3. By galvano-puncture or farado-puncture of the sheath of the nerve, or of the nerve itself.

In very fat subjects the first method is generally unsuccessful, as the amount of adipose tissue intervening between the electrode and the nerve (fat being a non-conductor) precludes the possibility of the current penetrating deeply enough to act upon the diseased part; recomposition taking place in the more superficial structures; hence Duchenne suggested the treatment by the rectal rheophore. In my hands galvano-puncture has made the most brilliant cures, and when properly performed is not by any means the painful operation it would seem at first sight to be. Indeed I never yet have performed it upon any patient who did not gladly welcome its repetition; the relief obtained from the agonizing pain was in the first instance so great.

To further illustrate this fact I copy the subjoined case from my note book.

Case XL.—Mr. Thos. I., æt. 40, was sent to me for treatment April 2d, 1877, by my friend and late colleague, Dr. Everitt Hasbrouck, of Brooklyn. I found him suffering terrible pain in the right thigh, behind the great trochanter; also in the popliteal space, and in the heel of same side; he was unable to move in bed without the greatest aggravation of his sufferings, and standing or walking was out of the question.

He gave me the following history of his case: About two years ago, he had a severe fall from a wagon, on the right side of the gluteal region, which ecchymosed the part considerably, and made him lame for several days. As he got better of the injury, he noticed occasionally a pain in the outside and back part of the thigh, which would sometimes shoot up to the small of his back. He at first thought nothing of it, especially as it would sometimes not trouble him for several weeks, and only

last a day or two; but each attack became more and more severe, until about six months before my first visit, when he was obliged to go to bed and call in medical assistance.

His first medical adviser (old school) dosed him with anodynes, blistered him, etc., until finding these nostrums of no benefit, he called a specialist in consultation, who scientifically cauterized the skin over the nerve, but it was not of the slightest use, but made him worse; then to relieve the pain of the mischief done, he injects morphia subcutaneously, twice and three times a day, for several days. This, the patient says, gave him great relief from the pain for a time, but made him otherwise so sick, that he made up his mind not to continue it, as it did him no permanent good; so he sent for Dr. Hasbrouck, who, finding the case not amenable to ordinary remedies, referred him to me for electrical treatment. He was now so reduced in flesh and strength, being in bed and unable to move since January 1st (three months), that I at once made up my mind that any interference must be of such a kind as to promise the most speedy relief; and thinking that electro-puncture was the most likely to ease the pain, I described the operation to the patient, who at once consented to have it performed.

I introduced two *very* fine hair-like needles into the nerve, about two inches apart, just where he felt the pain the greatest; these I attached to three small Daniells' cells, a rheostat of a hundred ohms being in the circuit; gradually I lessened the resistance, and finally removed it altogether. I moved the negative needle from place to place in the nerve during a seance of twenty minutes. The patient never once complained of the pain, but on the contrary, expressed himself much relieved at the close of the operation.

April 3d. Slept fairly last night, feels considerably improved.

4th. Better. Electro-puncture repeated.

5th. Still improving. Made external application with sponge electrodes.

6th. Better. Can turn in bed. Left patient a small galvanic battery to be applied externally according to directions, by one of his family, twice a day.

7th. Better.

8th. Better. Can sit up in bed for several minutes at a time.

9th. Not so well. Repeated electro-puncture.

10th. Better.

Without going into further tedious details, I would conclude the history of the case by saying that this patient was entirely cured in a month, having had seven treatments by electro-puncture, and about forty external applications of the galvanic current. Faradization of the weakened muscles being also used about five or six times. I have used electro-puncture in several other cases with success. Dr. Hammond* recommends the treatment, and says he has cured ten cases of sciatica by its use.

External galvanization of the sciatic nerve is by far the most commonly used of the forms mentioned, and often, especially in lean persons, makes a speedy cure.

The case annexed is reported by Dr. Moritz Meyer.†

Case XLI.—Carl Maass, æt. 34, a journeyman baker, short and thickset in form, previously healthy, had for the last few years been frequently subject to rheumatism, and about three months before the treatment of his case, had been suddenly seized with an attack of lumbago, to which was soon afterwards added a continuous pain in the posterior and lateral portions of the right thigh, extending to the knee. The pains were particularly intense in stormy weather, very severe at night, and whenever, after sitting a long time, the patient stood up, they became so intense, that he was obliged to support himself with both hands before he was able to take a step. Cupping, vesicants and Russian baths were used with none or at least with transitory effects. The patient had consequently found himself obliged to give up his employment, which was one requiring a standing position. On the 19th of April, 1861, he applied to me for treatment. He complained of a constant, penetrating pain near the tuberosity of the ischium, adjoining

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* *Diseases of the Nervous System*, page 835.

† Op. cit., 321, et. seq.

the point of egress of the N. ischiaticus, which from evening to midnight was especially severe, but did not trouble him during the morning hours; it was greatly intensified by pressure. The skin over the suffering parts was, when pinched, very sensitive; but on the other hand the pressure of the femur on the cotyloid cavity, produced no pain; the appetite was good, evacuations regular, pulse normal. One of the conductors having been applied, in combination with the apparatus of Stöhrer, to the point of egress of the sciatic nerve, the other behind the capitulum fibulæ, a current of about ten minutes' duration was transmitted. The patient was at once able to walk with more ease; he still went up stairs laboriously, but, by treading carefully, he could go down without pain. The pains continued till past midnight, and recurred again late in the following evening, though with much less intensity than before, and towards midnight passed off. After the third application of induction, electricity made in a similar manner, for the same length of time, the sciatica disappeared, and the patient returned from Spandau to Berlin, a distance of two miles, so as to assure himself of the perfect success of the cure."

By consulting any text book on medical electricity, the reader will find that these cases are not picked out to seek to prove a theory; nor because they happen to have been cured, but because they are *fair* representative types of the average cases we meet with, and give a general idea of the effects of electrical treatment. The student who wishes further light on the use of electricity in sciatica would do well to consult the treatises of Meyer, Benedict, Rosenthal, Poore, Anstie, Lincoln, Althaus, Hammond, and Beard and Rockwell, where they will find all the above strongly corroborated, and will also find numerous similar cases narrated which vary but little in result.

Other forms of neuralgia, as laryngeal and pharyngeal neuralgia, gastralgia, neuralgia of ovaries, uterus, bladder, and other internal organs are amenable to electrical treatment. I regret that I can as yet give no indication which current to use. The beginner had better commence with a very mild galvanic current, as he is less likely to produce serious aggravation than with the faradic.

CHAPTER XVI.

DISEASES WHICH SIMULATE NEURALGIA.

Myalgia.

The rheumatic pains occuring in muscles from exposure to cold and damp, are often mistaken for and confounded with pure neuralgia. A little attention to the symptoms will however avoid any error in diagnosis.

1. In myalgia the pain does not follow the track of any nerve, but is diffused over the muscular structure. 2. The pain is only felt, or at least is most severe on moving the affected muscles whereas in true neuralgia it is generally complained of as severely, whether the patient is at rest or in motion. 3. Most commonly stiffness and soreness of the affected muscles is associated with it. Faradization with a pretty sharp, rapidly interrupted current, can *always* be relied upon to give immediate relief from the pain, but it generally returns, in from four to five hours, though less severely than at first. A repetition of the treatment will again remove the pain and stiffness, but as before it generally returns, though at a further interval, and with much less severity. By giving a treatment upon each accession of the pain, four or five seances are all that most mild cases require. I have seen patients actually crippled and unable to move from an attack of myalgia in the dorsal and lumbar regions, leave their bed and walk briskly around the room, after a five minutes' application of the faradic current.

The Pains of Locomotor Ataxy.

The wandering pains occurring in this terrible disease, generally attacking the muscles of the thighs, calves of legs, or shins, and after moving around these parts for a while, suddenly leave, and locate themselves in other parts of the body, have, in the early stages of the disease, before the ataxia was diagnosed, been mistaken for neuralgia. These pains can

sometimes be relieved by one or other form of current. Sometimes on the other hand electricity produces no effect whatever, but very seldom aggravates.

The most remarkable effect I think I have ever seen electricity produce, was in a case sent to me for treatment by Dr. John F. Gray. The pains were relieved by faradization, almost upon the touch of the electrodes, and the patient would remain free from them for several days afterward. I do not mean my readers to imagine for a moment that such a brilliant result is to be at all expected, even in a small percentage of cases. I mention it here merely as an exception to the general rule. As far as my own personal experience goes, electricity cannot be *relied* upon as a *certain* remedy for diminishing these pains any more than it can as a remedial measure in arresting the pathological condition. (See page 77.)

Gout and Chronic Rheumatism.

Pains which occur in chronic and latent forms of gout and rheumatism, we often hear called neuralgic, and sometimes indeed it is no easy matter to distinguish between these diseases and true neuralgia; especially when they attack such parts as the eye, the dura mater, the stomach, the back part of the thigh, and even the foot. A careful examination of the history of the case, the diathesis of the patient, and a comparison of the essential characteristics of the diseases, will generally let us out of the difficulty. As regards the benefit of electrical treatment in these affections, I would say, that when these diseases attack muscular structure, frequent applications of the faradic current will generally give both patient and physician entire satisfaction; but in rheumatic or gouty arthritis, the length of treatment required is very much greater and often unsuccessful, even after persevering experiments with both forms of current.

Althaus* says:—"In acute and chronic rheumatism of the muscles, both galvanization and faradization are invaluable remedies. I have cured many cases of long standing by one

* Op. cit., page 625.

or two applications. Rheumatic effusions in the joints are likewise amenable to faradization and galvanization, but require a longer treatment than muscular rheumatism." He however, gives a report of several instances in which he has cured muscular rheumatism, but does not report one single case of articular rheumatism. Remak, Frommhold, and other authorities make favorable mention of the treatment of rheumatic effusions into joints by galvanism transmitted transversely through the part affected, with frequent reversal of direction. However, I must confess that I have tried this method and every other, and occasionally with success, but the result of my experience has been to teach me not to rely upon it wholly as a remedy in every case of rheumatic arthritis. The adhesions that occur as a consequence of this disease may be broken up and removed by producing strong muscular contractions with a slowly interrupted faradic current. However, this is surgical interference, and will be again alluded to under the heading:—Mechanical uses of Electricity.

Pains of Syphilis.

Under this general heading I include the pains that occur in tertiary syphilis on the commencement of formation of nodes; and also the *dolores osteocopi*, which occur in the early stages of the secondary eruption, and often even before this latter is fully developed. It is with the first mentioned form that we are most likely to confound true neuralgia, especially when the pains are complained of in locations commonly attacked by neuralgia, such as the malar bone, parietal eminence, lower jaw, near mental foramen, etc. Now, although as the progress of the disease advances, and the formation of nodes takes place, the similarity of the two diseases becomes less and less; still at the outset this similarity is so great, that even the closest observer or most perfect diagnostician may pardonably mistake a syphilitic node for true neuralgia;* especially when the correct history of the case is withheld by the patient. The second variety of pains, the dolores osteo-

* See Neuralgia and its counterfeits. Anstie, page 260.

copi, are not so likely to be mistaken for neuralgia, there being many points of difference. The minutiæ of the points of differential diagnosis is admirably given by Anstie in his treatise already referred to, and obviously has no place in these limits. What we have here to do with is, having diagnosed the disease, to point out whether electricity will do anything to relieve our patient. It certainly will. In the first mentioned form of trouble, galvanization at frequent intervals will relieve the intense pain, until we can give the remedy indicated for the dyscrasia time to act. Of the second variety I have had no experience, or so little that I do not feel justified in taking it into consideration or expressing an opinion. Beard and Rockwell* state, that "The severe pains of secondary syphilis are to a certain extent relievable by general and localized faradization, as we have demonstrated in a few instances; concerning the permanency of their effects, we have as yet no positive evidence." Other writers, as far as I am aware, do not allude to the matter.

Pain in General.

The pains occurring in chronic alcoholism, the pains of the passage of a biliary calculus, or even sometimes of a renal calculus, the pain of colic, and of a number of other peripheral irritations, may sometimes be mistaken for neuralgic conditions. As regards the electrical treatment, however, a mistake in the diagnosis of the diseases *named*, is not of very great importance, as they all readily yield to electrical treatment, and with much more rapidity than neuralgia. It is, indeed, a curious fact that all kinds of pain can generally be more or less influenced, curatively, by one or other form of electrical current; even the terrible pain of cancer in the last stages can be completely and entirely subdued by the galvanic current, after all kinds of narcotics and anodynes cease to induce the slightest repose.

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* Op. cit., page 627.

CHAPTER XVII.

ANÆSTHESIA.

Hysterical and other anæsthetic conditions of the skin involving the fibrillary terminations of superficial nerves, where the lesion is not of such a kind as to cause a break in continuity between the nerve-trunk and the nerve-centre, or a destruction of the nerve-centre itself, is perfectly curable by electrization; a very strong faradic current applied by metallic contact, is most generally the preferable agent. Electricity seems to be homœopathic to this condition by its primary or immediate action; and to hyperæsthesia by its secondary or ultimate effects. (See pathogenesis, page 26.) All the allopathic authorities admit that anæsthesia can be produced by a powerful faradic current during the transmission of such current. This fact has long ago been utilized for the purpose of dulling the pain in minor surgical operations,* as the extraction of teeth, etc. Francis, a dentist of Philadelphia, was the first who made use of electricity for this purpose. His example was afterwards followed by several other dentists in this and other countries. Dr. Morel-Lavalée used it for the same purpose in opening abscesses and excising small tumors. The introduction of nitrous oxide gas, as well as the unreliability of the induction machines which were then used, has caused it to fall into disuse. For evidence that it will cure anæsthesia, when occurring idiopathically, we have only to refer to any text book on electro-therapeutics, or diseases of the nervous system.† Hammond says: "Electricity is the most efficient agent to be employed towards restoring the irritability to the nerves. Sometimes the primary current is to be preferred; at others, the induced. In the latter case the wire brush should be used as one of the electrodes, and the anæsthetic parts stroked with it at each *seance*." Erb‡ gives his opinion very

* Archives of Neurology and Electrology, vol. I., page 109.

† Diseases of the Nervous System, page 826.

‡ Diseases of the Nervous System, Tiemssen, page 228.

emphatically and decidedly as follows: "By far the most effective of all the remedies that can thus be applied, is indisputably electricity, a means of excitation that may be employed in the most various degrees of intensity, and can everywhere be applied with the utmost facility, and without being followed by any unpleasant secondary effects." Althaus* records several cases caused by a diversity of pathological conditions all cured by electricity. Dr. Fieber,† of Vienna, considers it the most important remedy, and says: "Electricity is in most of the cases a sure remedy, excelled or even equalled by no other—by means of which we are able to remove the different degrees of diminution of sensibility." And so I might go on quoting almost infinitely, all are agreed on the subject. They admit that electricity produces anæsthesia. They admit that electricity cures anæsthesia. How can it do both and not be homœopathic? This question I leave for them to answer.

Muscular Spasm.

As types of this affection I would mention spasm, either tonic or clonic, of any of the facial muscles, torticollis and pharyngeal spasm, or dysphagia. The last mentioned form is often symptomatic of some grave cerebral disturbance, and even when so occurring, is to a certain extent relievable by electrization; and when not so dependant, but arises from local causes, yields (as Beard and Rockwell express it) with surprising readiness to external faradization. Facial spasm generally requires a long, steady and persevering treatment. Electropuncture of the affected muscle is perhaps on the whole the most reliable treatment. Torticollis is still more troublesome to treat; I have had but little personal experience with it. The opinion of most observers seems to be, that when treatment is begun early, it is curable by electricity, otherwise it is not; though to a certain extent relievable. Dr. Poore‡ on the whole has had good results, and has reported some very interesting cases.

* Op. cit., page 590.

† Electricity for Nervous Diseases, page 42.

‡ Electricity in Medicine and Surgery, page 221 to 226.

CHAPTER XVIII.

PARALYSIS.

To prove that the transmission of a powerful current of electricity through a muscle will temporarily paralyze it, is no very difficult task; in fact, any one possessing an ordinary induction machine can, by transmitting a current through any muscle, readily discover that at first strong and violent contractions are produced, and as the application is prolonged, the contractions diminish in vigor, until finally the muscle ceases to contract to the electrical stimulus, or even to the mental stimulus. In other words, it is paralyzed. Of course the larger the muscle, the longer must be the application and the stronger the current. This fact is known to and acknowledged by all the allopathic writers on electricity. The following extract is from Poore:† "Select a small muscle, (and it is well to select one that is not very frequently called into voluntary use for ordinary purposes), such, for example, as the first dorsal interosseous muscle of the left hand. Faradize it, using a current of sufficient strength to cause a contraction which is too forcible to be overcome by the will, and it will be found that after three or four minutes the contraction will become less and less strong as the irritability diminishes, and that the will is soon able to overcome the artificial contraction, while the same current applied to the corresponding muscle on the opposite hand, causes a contraction against which the will is absolutely powerless. Ultimately the faradized muscle will refuse to respond to either mental stimulus or faradism." Duchenne† writes: "There is certainly no need of experimental medicine to inform us that in its therapeutic aspect localized faradization is a two-edged weapon. Empirical observations very soon convinced me, at the beginning of my electro-therapeutical researches, that localized faradization if applied to a muscle or nerve for too long a time, or in too full a dose, may

* Op cit., page 108.

† *Localized Electrization*, page 151 and 155.

increase or even produce paralysis or atrophy instead of curing either. It was such clinical observations that led me to lay down the precept that muscular faradization must be moderate in degree, and that neither the whole application, nor the application to any single muscle should be unduly prolonged." * * * * * * * "It is indeed shown, both by clinical observation and experiment, that neuro-paralytic hyperæmia is a morbid state that is seen in atrophic paralysis, consecutive to lesions of the cerebro-spinal centres or of the nerve trunks. It is rational to conclude that any agency which increased the neuro-paralytic hyperæmia would aggravate the pathological state. But this is precisely the opposite of what I have witnessed, when, by the aid of faradization, I have cured the cases of atrophic paralysis that have been brought to me in such a condition. Under the influence of the treatment, I have seen the color of the skin and the nutrition of the paralyzed limb return in a short time to their normal state; while at the same time the paralysis underwent improvement, and I have considered under these circumstances that the vascular tonicity had been increased by the localized faradization. On the whole the clinical facts teach that as far as regards therapeutics, we should take into consideration the secondary and ultimate, rather than the immediate effects of electrization."

Valentine,* Eckhard and Matteucci give as the result of their experiments that the constant current, transmitted with considerable intensity, is capable of paralyzing nerve or muscle, both as to motion and sensation. We have already recorded instances of the paralyzing effects of lightning; and the paralyzing action of statical electricity is too well-known to need more than passing notice. Hence we see that every known form of electrical current is capable of producing paralysis.

Such paralysis may be of a transient, functional nature, and may pass off in a few minutes, hours or days, as the case may be, according to the intensity of the action of the force producing it, or it may, by producing an absolute pathological lesion of the nerve trunk or nerve centre itself, cause a perma-

* *Medical Electrization.*—Meyer, page 62.

nent and complete paralysis that may go on even to atrophy, just similar to the cases of peripheral or central paralysis that we every day meet with occuring idiopathically, and which we expect to cure by the very remedy that I have just shown produces them.

There is no lack of evidence of the curative power that electricity exerts in this disease. The very same books (every one of them) from which I have just quoted, recommend the very agent which they positively demonstrate has over and over again indisputably caused paralysis, as their sheet-anchor in all paralytic affections, and their *only* hope in certain cases.

In the history of electro-therapeutics the first case of any kind we have recorded as cured by its means, is a paralyzed finger, treated by Kratzenstein, in 1744, and for many years after this date, the therapeutical uses of the current was almost wholly confined to the treatment of paralytic diseases. Up to the present, we have more useful medical literature on this subject than we have on any other in the whole domain of electrology. The kinds of paralysis which electricity will cure, those cases which it will ameliorate but not cure; and those in which we can expect no benefit through its agency or any other, are accurately pointed out, and culled one from the other, with great precision by many observers; and even the instructions in the fine technical details as to how often the seances should be repeated, how and where the electrodes should be applied, the motor points for all the muscles in the body, the adaptation of special instruments for the treatment of special cases, etc., are given with an exactitude that we as a profession may well be proud of. It is not claiming too much to say that the treatment of paralysis by electricity is now reduced to a positive science; if, indeed, any part of the practice of medicine can with propriety be called such. These matters will be fully entered into when we come to the parts of this work devoted to methodology, electro-diagnosis and prognosis, etc. What we have to do with in this part is, to positively demonstrate that it *will* cure certain forms of paralysis. For the purpose of description, it is necessary to adopt some of the various classifications of paralysis. That used by Beard and Rockwell

singer. Dr. J. Russell Reynolds* recommends the use of statical electricity in preference to the faradic current. Of this I have had no experience, the faradic current having made brilliant cures in all my cases.

Hysterical paralysis occurring in other parts of the body is quite curable by faradization, even after atrophy of the affected muscles has occurred. For cases, see Medical Electricity, Althaus, page 450; Electricity in Medicine and Surgery, Poore, page 141; Beard & Rockwell's Treatise, page 502, *et seq.*

Rheumatic Paralysis.

During the years that I had charge of the Department of Diseases of the Nervous System in the Brooklyn Homœopathic Hospital Dispensary, I had ample opportunity to witness the effect of electrical treatment in this affection. The parts most commonly attacked were the deltoid, trapezius and biceps muscles, next the extensor muscles of the forearm; cases also occurred involving the muscles of the eye, interossei of hand, and other locations, but very rarely. Direct and indirect faradization of the affected muscles, repeated two or three times a week, was generally the treatment given, and with *entire* success, even in old standing cases that had resisted various kinds of treatment previous to their coming under my charge. Althaus* expresses his opinion thus: "There is no kind of paralysis in which the therapeutical effects of faradization are so striking as in rheumatic paralysis, in which affection it cannot be replaced by any purely medicinal treatment. This applies also to protracted and severe cases which have resisted a variety of energetic therapeutical measures."

Lead Paralysis.

This disease is caused by the absorption of some salt of lead into the system, either by using face powder containing lead, or by the constant handling of paints, containing the carbo-

* Clinical Uses of Electricity. p. 100.
* Op. cit., p. 531.

nate of lead. Consequently painters, and those employed in the manufacturing of paints, are as a class the most liable to this form of paralysis. It is a disease which almost exclusively is limited to the hands and arms. Commencing with trembling in the hands, it soon spreads to the extensor muscles of the forearm and thenar eminence; and afterwards as the disease progresses, to the biceps and deltoid muscles. It is a strange fact, that the flexor muscles of the forearm are never attacked. Atrophy comes on early and proceeds with great rapidity, and the electric contractility is lost early. Of course, the first indication is, to remove the lead from the system, and secure the patient from a further absorption of it; but this alone will not cure the paralysis. We must also use a remedy that will restore the tone, and improve the nutrition of the impoverished muscles, and there is no remedy that will do that but electricity. In most cases the response to the stimulus of the faradic current is entirely lost before the patient calls on a physician. In such we must use the galvanic current as the remedy, and after a few applications, we find that the muscles begin to respond to the faradic current; then this form of electricity must be substituted, and used daily, until the weakened tissues are fully restored to their normal vigor. Even in the mildest cases, it will take many weeks to accomplish this result, and in bad cases, where a great degree of atrophy is present, many months; still, no case need be abandoned as hopeless, and there is no other remedy that will answer the purpose. For cases illustrating these facts, see Althaus' work, p. 452; Medical Electricity, Tibbitts, p. 188; Meyer Op. cit., p. 283, *et seq;* also the works of Benedict, Poore, Beard & Rockwell, Reynolds and others.

Diphtheritic Paralysis.

As a sequel of diphtheria, we have a peculiar kind of paralysis attacking first one part and then another. To-day it may show itself in the muscles concerned in swallowing, and to-morrow, without any warning or apparent cause, we find it has left there, and located itself in one side of the face, one arm, one leg, or elsewhere.

After ending in paraplegia, Althaus says, that such cases generally end fatally. Such has not been my experience, however, on the contrary, I have mostly seen such cases get well spontaneously, that is to say without the assistance of any remedies. Faradization is, however, a great help, and I have treated many cases by its aid that I have no doubt recovered in a much shorter time than they would have done, if left to nature. Paralyses after typhoid fever are more liable to become atrophic, but yield to electrization.

Cerebral Paralysis.

Hemiplegia, the commonest form of this difficulty, is the result of cerebral hæmorrhage, embolism, or other mechanical interference by which the integrity of the great nervous centre is impaired. The more profound the lesion the more complete will be the paralysis, and where the whole corpus striatum is destroyed, the hemiplegia of the opposite side of the body will be complete, permanent, incurable. But in cases of the rupture of a small blood-vessel, where a small amount of blood is effused, just sufficient by its pressure to interfere seriously with the functions of this part of the brain, without destroying it, then we may have complete hemiplegia, but not incurable. The clot of blood becomes eventually absorbed; but, before that much desired result has had time to take place, the paralysis continues to get worse, and even though the primary lesion (the cause), be entirely removed, the paralysis remains, and the patient is unable to use his limbs.

If in a case of this kind we find that the muscles do not respond to the stimulus of the faradic current, but do to the galvanic, it is just the case to cure by electricity. Commence with daily galvanic treatments, (each muscle separately), with just sufficient electro-motive force to cause perceptible contractions, and soon the improvement will become apparent, the patient will begin to move the limb, at first slightly, and afterwards better and better. The faradic irritability now becomes restored, and as it does, we must substitute that current for the galvanic, until the cure is completed; which it will be in

time, varying in length according to the extent and duration of the disease previous to commencing the treatment. But suppose another case. Suppose instead of finding the muscles flabby, wasted, we find an amount of permanent contraction, and that the electric-contractility to both forms of current is perfect, but the paralysis to the will remains, then electricity is not indicated, and consequently will not cure or even ameliorate. It is no use persisting in it; it is only harassing to the patient, and loss of time to the physician. We cannot cure a fever with Aconite, where the symptoms call for Gelseminum. Nor can we cure any disease with any remedy that is not indicated by the symptoms. To illustrate the ordinary progress that suitable cases of hemiplegia make under electrical treatment, the accompanying cases are quoted:

Case XLIII.—Reported by Beard & Rockwell.* "Mr. H., a bank president, æt. about 45, after having enjoyed excellent health previously, and having always led a correct life, was suddenly prostrated one morning while dressing, by a slight sensation of vertigo, and a feeling of utter exhaustion. In the course of an hour these symptoms were followed by a partial paralysis of the right side. He was unable to walk alone, but if allowed to lean upon another for support, he could slowly and with difficulty make his way from one room to another. In order that the case may be fully appreciated, it will be necessary to notice his physique, and speak of his past history.

He was tall and very thin, with a tendency to anæmia rather than plethora. He had always enjoyed a fair degree of health, and for many years there had scarcely been a perceptible variation in his weight. His present position was not at all onerous, but most of his life had been spent as head of a business firm, that had taxed his energies to their utmost.

For some months previous to his illness, he had suffered from excessive anxiety because of financial embarrassments, but especially because of the inefficiency and carelessness of his son, to whom he had entrusted certain details of his business of much importance. His mental condition produced in-

* Op. Cit., 513.

somnia, that finally resulted in a sudden collapse of the debilitated nerve centre. An application of general faradization caused immediate but only temporary increase in the power of the paralyzed members, as may be so frequently noticed in cases of hemiplegia following effusion. On the succeeding day, however, very marked and permanent improvement was observable, an idea of which may be conveyed by stating that he was able to do what was before impossible, viz.: to put on his pants without assistance. Treatment was given every other day, and resulted in very rapid progress toward recovery. In the course of a month, he could walk with such ease and readiness, that no one would have supposed that he was in any way disabled. He could not, however, run with any ease or comfort; and though nearly two years have elapsed since treatment was discontinued, he does not feel that he is able to engage in any exercise more severe than a rapid walk."

Case XLIV.—Reported by Tibbits*. "A lady, æt. 41, had suffered from right hemiplegia for eighteen months, and described her condition as having remained without improvement for the past six months. She had recovered sufficiently to walk with the aid of a stick, but the movements of the arm were very weak, especially those of the deltoid, extensors of the fingers and individual muscles of the hand. Faradic contractility was somewhat lowered, but there was no rigidity.

The muscles were carefully faradized with a current just sufficiently strong to produce their contraction. The entire application occupied about fifteen minutes, and was made once daily. After a fortnight's electrization, she was able to raise the arm to a right angle with the body, and to use the hand to feed herself, neither of which she had been able to do before treatment."

Cases like these, both as regards the disease, and the results of the treatment are of every day occurrence in the practice of the electro-therapeutist.

By this I do not mean to say that any student or physician who has never paid any attention to electro-therapy can treat

* *Electricity in Medicine*, page 171.

such cases, and get such, or anything approaching such results; on the contrary they are liable to do a great deal of mischief. The ownership of a knife does not make a surgeon, nor does the ownership of a set of electrical instruments (no matter how handsomely they may be gotten up), make an electro-therapeutist. Far from it. Both must have acquired skill in their special departments, and skill everybody knows is only acquired by special talent, special education and special experience. The technical details of the treatment of a case of hemiplegia requires not only a knowledge of anatomy (as each muscle must be electrized separately), but just as thorough knowledge of electro-physics, and the other necessary branches of the science as any other disease needing electrical treatment.

This point is too frequently overlooked, and electricity is ordered; the family physician sends out his "fiat." "Let the patient be electrified," and the patient is electrified. How and by whom? Generally in a modified form of the method already described at page 65, and by such operators, and with about the same results. This will not do. A case of hemiplegia must be treated with just as much care and precision as we would conduct an operation requiring electrolysis of a morbid growth on the conjunctiva. If the operator has not the skill for one let him rest assured he has not for the other.

Spinal Paralysis.

We have already cursorily alluded to the benefit to be expected from galvanization of the spine in this disease, we will now consider what cases we would expect to benefit by electrization of the muscles.

A case of paraplegia, consequent upon hyperæmia or anæmia of the cord, concussion of the spine, or any cause that temporarily interferes with the functions of the cord where atrophy of the muscles has not progressed to absolute destruction, and where the primary cause of the paralysis has been to some extent removed, or is removable, is one in which we would expect a favorable result from electrization of the muscles and spinal cord itself. In cases occurring from the same

causes, in which but little atrophy has yet taken place, and in which electric contractility is tolerably perfect, galvanization of the spine will speedily restore to a healthy condition without having to touch the affected muscles at all. But in cases of fractures, caries of the spine, tumors pressing upon the cord, or any disease that destroys the cord, we have a paralysis that we may look upon as permanent, although in such a case we may do much to relieve the sufferings of a patient temporarily by the judicious use of electricity. We may relieve or even for a time entirely check incontinence of urine by faradization of the paralyzed bladder, or involuntary stools by applications to rectum and anus, and by using electricity where the symptoms indicate it in a number of "*little*" troubles incidental to this disease that tend to make a patient's life unbearable if not relieved.

In infantile spinal paralysis, which is generally due to inflammatory softening of the anterior portion of the gray spinal substance, the result of exposure to cold damp, etc., electricity stands unrivaled as a remedy. This form of paralysis is generally ushered in by a chill, a convulsion or slight febrile condition, with pain in the back at the seat of the primary lesion.

After a few days it is noticed that the child cannot stand or walk; and if the lesion is high up in the spine, cannot use its hands. After this the disease rapidly progresses to atrophy.

A case of this kind sent to me for treatment by my friend, Dr. W. T. Helmuth, presented all the salient symptoms in a remarkable degree, as the following report shows.

Case XLV.—Mary N., æt. 3, was brought to me October 14th, 1870. *Status præsens.* Could not stand or walk. Slight movement of both legs possible when lying on back; temperature of both legs much below normal. *No muscular contraction to faradic current.* Slight atrophy. No tenderness of spine to touch, but the slightest application of the faradic current to last dorsal and first lumbar vertebra, made the child scream with pain. Other parts of the body well nourished. General health good.

History. On September 20th, after a slight febrile attack on the previous week, it was noticed that the child could not

stand. The mother becoming alarmed sent for a country physician, who diagnosed the trouble as an injury of the spine, and insisted that the nurse must have let the child fall, and that the paralysis was the consequence. As the child got rapidly worse after being three weeks under his treatment, the mother applied to Dr. Helmuth for advice, who at once kindly referred the case to me. I commenced treatment by galvanizing each of the paralyzed muscles separately, and made applications to the lower part of the spine, twice a week, until the 24th, at which date all the muscles responded to the faradic current except the tibialis anticus, and peronæus of left side. Now substituted the faradic current for the galvanic previously used (daily applications), but still continued the galvanic current to the spine twice a week.

November 18th. Much improved; can stand with assistance. Treatment continued.

December 5th. Can stand and walk a few steps with a little assistance. Continued treatment.

January 9th, 1877. Can walk alone slowly, with a little inclination to bear on the outside of the feet, particularly the left. 27th. Walks quite straight and can run.

February 6th. Improvement continues. Faradization discontinued. Spinal applications twice a week.

February 29th. Dismissed entirely cured*.

Peripheral Paralysis.

Perhaps the most important of all the paralyses coming under this heading is that known as facial or Bell's paralysis. The portio dura is the nerve affected, and when (as most commonly is the case), it is caused by exposure to cold, or rheumatism, or removable pressure, after the emergence of the nerve from stylo-mastoid foramen, it is curable by electricity, provided very extensive atrophy has not yet taken place, and galvanic contractility is not entirely lost. But on the contrary

* It is but right to state that during the first two or three weeks of the treatment, the patient took various remedies that the symptoms at the time seemed to call for, but apparently without any effect.

when the lesion is in the aquaductus Fallopii, or stylo-mastoid foramen and cannot be removed, then electricity will not benefit*. The longer the disease has existed, the greater will be the atrophy, the less the response to the *galvanic current*, and the longer the treatment necessary. I say the galvanic current, as the faradic reaction becomes lost so early in the progress of the affection, that it cannot be taken into any practical account.

The following case was sent to me by Dr. Whitney in October, 1874:

Case XLVI.—A gentleman, æt. 41, commercial traveler by occupation, had caught a severe cold, which was followed by a faceache with considerable swelling. When the acute symptoms subsided, he found that he was unable to close his left eye; that when he smiled, the mouth and whole face was drawn towards the right side; that his food lodged between the gums and the cheek of the left side; he could not spit out or whistle. The ala of the left side of the nose was depressed; or to use the patient's language, the left side of the nose had grown smaller. Even under these circumstances he was not alarmed, and did not apply to any physician, thinking his condition was only the result of the swelling of the face and would soon wear off. At the earnest solicitation of his family, after the paralysis had continued six weeks, he called in his family physician, Dr. Whitney, who accurately informed him of his condition, and referred him to me for treatment. I found the faradic contractility entirely gone, and the galvanic nearly so, and notwithstanding that the disease had existed comparatively but such a short space of time, all the muscles were considerably atrophied. I gave a favorable prognosis, provided the patient would submit to daily treatments. I treated him for three months with mild applications of galvanism to the affected nerve, and to the affected muscles separately. At the end of that time, the faradic contractility returned slightly. I then alternated the use of this with the galvanic for a month longer, after which I instructed the patient in the use of the faradic,

* For diagnosis as to the location of the lesion, the reader is referred to any text book on nervous diseases, *e. g.* Hammond, Erb, Trousseau, *et alt.*

and ordered him to make applications twice a day, and call every week. In April he could close the eye, draw the mouth somewhat towards the affected side, the ala of the nose resumed its former appearance, the food discontinued to lodge outside the gums, he could spit without dribbling. But he could not frown; and when he smiled, the mouth was still drawn towards the affected side, showing that paralysis of the corrugator supercilii still remained, and that the risorius and zygomatics of the diseased side were not as strong as their fellows. He, however, steadily improved, and a little later I dismissed him cured. Two other cases of facial paralysis under treatment at the same time, recovered, one in three weeks and the other in about four months. The first had existed only two days when I saw the patient, and faradic contractility was perfect. The other more than two weeks, and the faradic response was less than normal, but no atrophy had taken place.

Other paralyses caused by peripheral lesions are amenable to electrical treatment. A common form is paralysis of the muscles of the arm from pressure on the brachial plexus. I had one case occur in a man who had to temporarily use a crutch on account of a broken leg, yield to a few seances of faradism; whereas in another which happened in consequence of the patient going to sleep in a railway car, with his arm over the back of the seat, I was obliged persistently to use faradism daily for three weeks, before the muscles fully recovered. In the first case it will be noticed that the pressure, though longer, was intermittent, and between the short uses of the crutch, the nerve had a chance to partly recover, and in the latter case, the pressure probably was continued for eight or ten hours; as I have reason to believe it happened while the patient was intoxicated. It is impossible in a work of this kind, to enter into the detail of the different locations liable to be attacked by paralysis, and the different causes that may produce it; it would unnecessarily fill a volume. As far as the electrical treatment is concerned, and that is what we are interested in at present, we will generally find that if the muscles are not completely destroyed by atrophy, that the electric contractility is not lost, and that the primary lesion is capable

of removal; that the paralysis is curable by a suitable form of electrization; and even some in cases where the contractility is lost, much good may be done by patient and long continued perseverance with the galvanic current; always remembering that each muscle and nerves must be acted upon separately. Shooting into the bush to kill the bird, will not do; we may make a hit, but we are more likely to make misses. We should bear our anatomy well in mind—the motor points—and the attachment and insertion of the muscles, as well as their relative positions. Do not fatigue the enervated parts by long and protracted seances. If a muscle responds to the interruptions of the current at the commencement of a treatment, and then the contractions become weaker to the same strength of current, we are doing no good by continuing the application; on the contrary, we are aggravating the affection. We must let it alone, and go on with another muscle (one at a distance is preferable), always bearing in mind the maxim of Duchenne, that "electricity, if applied to a nerve or muscle for too long a time or in too full a dose, may increase, or even *produce* paralysis or neuralgia, instead of curing either."

PART III.

CHAPTER XIX.

METHODOLOGY.

We will now take up for consideration the proper methods of transmitting an electrical current through the different organs and tissues of the body, and in doing so must, for the present, presume that the reader understands at least an outline of electro-physics, and is familiar with some of the most common forms of electrical apparatus in medical use.

In making any therapeutical use of electricity there are a number of general rules that it is necessary for the beginner always to bear in mind.

I. In all external applications *thoroughly* moisten the electrodes with warm salt and water.

II. Never commence a seance with high current intensities.

III. Always have a galvanometer and a properly graduated rheostat included in the circuit in using the galvanic current.

IV. Do not unduly prolong seances. Remember, it is always better to do too little than too much.

V. Note accurately the maximum and minimum of the electromotive force transmitted, both by the number of volts and by the deflection of the needle. Although it is not always possible to foretell accurately what dose is needed, still it is well to be able to tell what we have administered, for future guidance.

VI. The electrodes should always be placed *in situ* before the current is allowed to flow.

VII. Be careful not to decompose the skin or mucous membranes. This is more liable to occur under the action of the naked metallic instruments used for mucous membranes, than with the moistened sponge rheophores used on the skin.

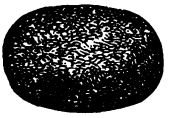
For the purpose of ready reference, an arrangement similar to that used in the pathogenesis is adopted. Thus we commence with a description of electrization of the head and cervical sympathetic, and proceed with the other parts in the usual repertory order.

HEAD.

For the purpose of electrizing the head, so as to affect the brain, the electrodes must be placed either one on each mastoid process, or one on each malar bone, or else one on the forehead and the other on the back of the neck. A pair of broad flat electrodes covered with sponge should be used. Those made of sponge-covered carbon are perhaps the best, as they are not liable to become oxidized and so break the circuit. (See Fig. 1.)

Transmissions of the current transversely through the head produce the immediate symptoms of galvanization in a much more marked degree than when the current is allowed to flow from forehead to occiput, but by the longitudinal method the secondary symptoms become most prominent. The brain may be affected also by placing one electrode on the head and the other on any part of the body, but there is no precision about that mode of treatment. We cannot tell how much of the force given off from the battery is utilized on the brain, and how much on the other tissues included in the circuit, as the resistance is increased by separation of the electrodes, or rather in the direct ratio of the amount of tissue between them, so the amount of current passing in a given space of time is lessened in an unknown degree, and for other obvious reasons the method is imperfect.

FIG. 1.



EYES.

To pass a current through the eye, so as to affect the retina and intervening structures, generally one electrode, such as that already described (Fig. 1), is placed upon the malar bone, and the circuit completed by an eye-cup (Fig. 2), filled with salt and water, placed on the closed eyelids, so that every part of the lids come in contact with the water; or an electrode, slightly cupped so as to receive the

prominent part of the eyeball, and covered with sponge, may be used instead, as suits the convenience or taste of the operator. When we want to locate the effects of the current in separate muscles or in

FIG. 2.

any of the special structures of the eye itself, we must proceed in a somewhat different manner, viz., the broad carbon electrode being placed as before upon the malar bone, and of course attached to one pole of the battery, an electrode like that depicted in Fig. 3, the tip of which is covered with moistened wash-leather, is applied to the muscle or part we wish to affect. To electrize the external rectus, apply it to the external canthus, pressing well within the orbit; in ptosis, over the upper lid; internal rectus or inferior oblique, at the lower part of internal canthus; inferior rectus, over the lower part of lower eyelid; superior oblique, upper part of internal angle, pressing upwards and inwards.

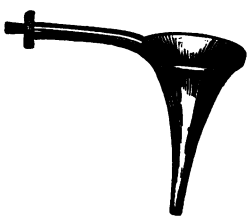
FIG. 3.

Applications to the conjunctiva should be made with the same instrument, but uncovered. Only very mild currents are needed.

EARS.

There are several methods of making applications to the ear: the one most commonly used is to have the patient rest his head upon a table, with the ear to be electrized upwards, then having filled the ear up to the meatus with warm water, introduce the insulated electrode (Fig. 4) into the ear, making the circuit by applying the electrode, Fig. 1, to the mastoid process of the same side, or to the back of the neck. Benedict places the latter in the hand, and so uses the patient's arm as a rheostat. Dr. Houghton uses a very small sponge-covered electrode, which is capable of being wholly or partially withdrawn within a rubber tube which fits the meatus. This is by far the best method, as it is possible by it to control to a

FIG. 4.



nicety the exact amount of surface with which the electrode is in contact, according as the rheophore is protruded or withdrawn into its insulated covering.

Another method is to apply the current to the mouth of the Eustachian tube by means of an electrode insulated to the tip, made like a Eustachian catheter, and introduced in a manner similar to that usually adopted in using the latter instrument, the circuit being completed by external application to the mastoid, back of the neck, or within the external auditory meatus. Besides these methods, we may transmit a current from one external meatus to the other, and so affect both ears.

CERVICAL SYMPATHETIC.

In order to bring the superior ganglions of this nerve within an electric circuit, we place one of the poles armed with a sponge-covered instrument, such as is shown in Fig. 5, high up in the auriculo-maxillary fossa, pressing it steadily inwards, the other pole attached to the broad sponge, either upon the seventh cervical vertebra or just above the sternum. Of course, in such an application a number of other parts, as part of the pneumogastric, spinal accessory, and glosso-pharyngeal nerves, are more or less acted upon; and no doubt many of the symptoms imputed to electrization of the sympathetic are really due to the effect produced on the first-mentioned nerves.

FIG. 5.

In cases where we wish to affect the sympathetic on both sides simultaneously, we may attach two of the sponge-holders just described to a bifurcated electrode, so as one will press behind the angle of each jaw, and complete the circuit in the manner just now mentioned.

In using such applications for therapeutic purposes, we should never use a current of sufficient tension, or make the seance sufficiently prolonged, to produce dizziness, or any of the immediate symptoms given under the heading Pathogenesis. The duration of the seance need *never* exceed two minutes, and the tension of the current six to ten volts, at a rough estimate, commencing the seance with a resistance of 800 to 1000 ohms in the circuit. This latter precaution is always essential.

NOSE.

The Schneiderian membrane can be acted upon electrically, by the application of one pole, to which is attached a metallic rheophore (Fig. 6), insulated to the tip, to any part of the membrane we wish

FIG. 6.

to influence. A large extent of the membrane can be acted upon by slowly moving the electrode over its surface. The circuit is most commonly completed by a sponge placed upon the forehead or nape of the neck.

MOUTH, TONGUE, TEETH, ETC.

The tongue, uvula, soft palate, tonsils, teeth, etc., are to be treated by the application of an insulated electrode, such as is shown at Fig. 7, the opposite pole being placed on the nucha; only the very mildest intensities of either form of current will be tolerated. The operator should be provided with different sizes of this instrument.

FIG. 7.

PNEUMOGASTRIC NERVE.

Duchenne's method of influencing this nerve electrically is by far the most preferable, and indeed the only one that should be used. The operation is performed thus:

A ball-tipped electrode (Fig. 6) with an insulated conductor is placed upon the lateral and inferior part of the pharynx, and the circuit completed by placing the other electrode upon the epigastrium. This includes the greater part of the nerve in the circuit.

Duchenne* says: "When it is wished to limit the action to the stomach and liver, an olive-shaped rheophore should be carried to

* Localized Electrization, p. 103.

the cardiac orifice, and the circuit completed by the second rheophore on the epigastric region." The caution expressed at pages 62 and 63 is earnestly recommended to the attention of the beginner.

PHRENIC NERVES.

By pressing an electrode, such as Fig. 8 represents, over the external border of the clavicular fasciculus of the sterno-mastoid muscle, and placing the broad rheophore over one of the lower intercostal spaces, we include the greater part of the phrenic nerve in the circuit. Both phrenics may be acted upon at the same time, either by means of a bifurcated conductor, carrying two such electrodes as that just described, or by applying one pole of the battery to each nerve. The first-mentioned method, however, is the most practical, and as a general thing all that is needed, and even when used for the resuscitation of drowned persons, we can act upon the diaphragm quite sufficiently to keep up artificial respiration, by alternating the action of the current upon the right and left phrenic.

FIG. 8.

SPLANCHNIC NERVES.

These nerves take their origin from the six lower dorsal ganglia of the sympathetic, and by placing a very large sponge-covered electrode over the spine at this location, and completing the circuit by a similar one on the abdomen, we have the action of the current transmitted through these nerves. A pair of electrodes something similar to Fig. 9 will answer the purpose best.

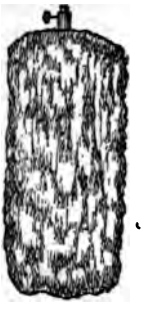
FIG. 9.

SPINAL CORD.

This part can be influenced in any portion of its extent by electricity. We can include any one part of it in the circuit without influencing any other. If the cervical portion is to be acted upon, an electrode like Fig. 1 will answer for the upper pole, and one like Fig. 9 for the lower. If any other part, a pair like Fig. 9 will be needed. Some physicians

when transmitting a current through the whole length of the spine, cause the patient to sit upon an electrode like Fig. 10, and use Fig. 9 for the upper pole. This method, however, is inconvenient and disagreeable to the patient, and has many obvious objections.

Fig. 10.



A current transmitted from the mouth to the anus includes the whole of the spinal cord in the circuit. Low current intensities are all that are generally necessary.

URINARY ORGANS.

Bladder.—Galvanizing or faradizing the bladder is a delicate operation, requiring tact, skill, and what may be called extreme nicety in the manipulation of the instrument, and attention to the many little minor details that are only to be acquired by long practice, and should never be attempted by the tyro electro-therapeutist until he has had considerable experience in using the current in other locations. The *modus operandi* is to place the patient upon the back, insert a catheter electrode, insulated except the tip (like Fig. 11), into the bladder, completing the circuit by a Fig. 10 electrode placed under the small of the back. If the galvanic current is used, the bladder must be emptied and injected with warm water, as otherwise electrolysis of the urine will take place, which in some cases might act deleteriously, especially when frequently repeated. This is a precaution unnecessary in using the faradic current, as no such result can occur; and it is well to have as much urine as possible in the bladder during the passage of the faradic current, as it acts as a conductor, and so the current is brought into contact with a large part of the internal surface of the organ.

Fig. 11.

The very lowest possible intensity of current should be employed at the commencement of seances and first applications, and if more than these should be needed we should feel our way very cautiously, gradually increasing the tension cell by cell. Some physicians recommend external applications, one electrode being placed upon the perineum and the other above

the pubis, and I must say in some cases of enuresis nocturnæ I have seen benefit follow its use, but generally the operation first described will be required.

Urethra.—In making applications to the urethra we must take into consideration whether we want to apply the current to the whole urethra or to part, and if to a part, to what part. If we want to act upon the whole urethral canal (an operation which is seldom called for), we introduce an ordinary uninsulated catheter electrode, and connect it with the battery pole we intend to use, and complete the circuit by a broad electrode placed either upon the small of the back, nates, perineum, or upon any part most convenient to the operator. When we want to apply electricity to the prostate, common ejaculatory duct, or to any one portion of the urethra without affecting any other, then we use an insulated electrode, something similar to the one shown at Fig. 11, but with a smaller portion of the tip uninsulated. In treating the female urethra the same instruments will answer.

The amount of current necessary to use will greatly depend upon the disease we have to treat; generally, low intensities are all that are required. A knowledge of anatomy and some experience in the use of catheters and sounds, will be of more use to the beginner than any printed instructions that could be given here. The disastrous results that may be caused through careless or ignorant manipulation of the instruments or by too strong currents are: First. Electrolytic destruction of the whole or part of the urethra. Second. Inflammation of the urethra, which may be followed by retention of urine. Third. By the use of the positive pole charged with the galvanic current an eschar may be caused which heals by contraction, and produces a stricture.

GENITAL ORGANS.

Penis.—In text-books there are quite a variety of rules laid down for electrizing the penis, most of them of no practical utility.

The best means is to wrap the organ around with one or two layers of moistened lint, over which is folded an electrode made of tin-foil; the second electrode, such a one as Fig. 12, being inserted into the rectum, about an inch above the sphincter; or if this latter is contraindicated, a sponge placed upon the perineum or lower part of

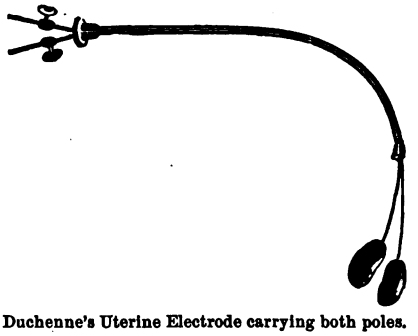
the spine will answer; the patient being in the position most convenient to the operator.

Testes.—When it is necessary to pass an electric current through both testicles, the most convenient mode of operating is to use a cup similar to that used for the eye, Fig. 2, but of course much larger; half fill it with salt water, and immerse the testes as far as possible in it. Connect the cup with the battery-pole in such a way that the water in the cup will have a *thorough* electrical communication with the battery. The second pole may be armed with the broad sponge electrode, and the circuit completed by placing it over the pubis. If it is necessary for any reason to galvanize or faradize one testicle alone, it must be done by a flat or slightly cupped electrode. It is an awkward proceeding at best, is painful even with mild currents, and not nearly so efficacious as the immersion method.

FIG. 12.

Uterus.—Considerable ingenuity has been displayed in the endless variety of contrivances that from time to time have been invented for applying electricity to the uterus: most of them are useless or nearly so, and need not be alluded to. A few of those generally used are shown in Figs. 13, 14, 15, 16, and 17. Of these each has its definite purpose to perform, and is useful for that alone. Duchenne's electrode, Fig. 13, is useful when we wish to pass a current

FIG. 13.



Duchenne's Uterine Electrode carrying both poles.

transversely through the cervix uteri. I give the directions for

using it in Duchenne's* own words: "It is introduced closed into the vagina, and then the two plates are made to separate, by pushing the stems onward through the double gum tubes which cover them. The operator guides each of the plates by the index finger

FIG. 14.

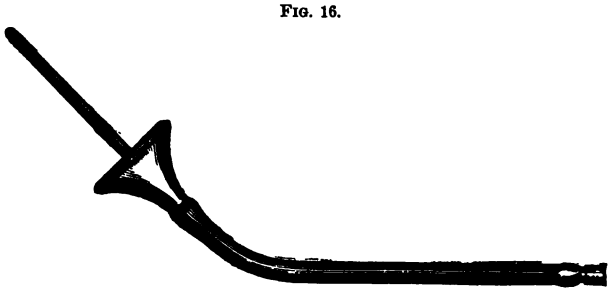
of his free hand, and places them upon the sides of the cervix. It then only remains to connect the stems with the poles of an induction apparatus."

Tripier uses two methods of faradizing the uterus. These he calls the vesico-uterine and recto-uterine methods. The first he uses

FIG. 15.

to remedy retroversions and retroflexions. He performs it thus: The patient lying on the back, he introduces an electrode similar to Fig. 14 into the cervix uteri, and completes the circuit by placing the bladder electrode in that organ, getting the tip of the instrument on

FIG. 16.



the posterior wall of the bladder, and so bringing it as near as possible to the uterus. The second method he uses to rectify antever-

* Localized Electrization, p. 96.

sions and anteflexions. In this operation the uterine rheophore is placed in the position just described, while another rheophore, mounted with a large olive tip, similar to Fig. 12, is passed into the rectum, above the uterus. He considers it necessary in treating flexions and versions to press the action of the current until strong *bearing-down* pains are experienced.

The ordinary method of electrizing the uterus is either to use the cup electrode, Fig. 15, applied to the cervix, or Beard and Rock-

FIG. 17.

well's electrode, Fig. 17, applied within the cervix, or the electrode shown at Fig. 16, which makes contact with these parts at the same time, attached to one pole, and the circuit formed by a broad sponge, applied over the sacral or hypogastric plexus externally, or sometimes over the region of the ovaries.

There is no doubt that the uterus is electrically affected by all of these methods, as it also is by transmitting a current from just above the pubis to the sacrum, by means of moistened rheophores placed upon the skin. All these methods have their peculiar advantages in certain cases; but they are all open to one objection, and that is, that the surrounding tissues are as much affected by the action of the current as the uterus is. This is a matter of no moment in some cases, and a positive advantage in others; still there are cases in which it is desirable to concentrate and localize the action of the current in the uterus, and to avoid acting upon the adjacent organs as much as possible; and, in order to do this, it is necessary to have an instrument which will locate both poles of the battery in the organ itself. I have had constructed by the Galvano-faradic Company of this city an electrode, which is shown in Fig. 18. The un-

FIG. 18.

insulated tip, *a*, of the stem, *a b*, is to be carried through the cervix to the fundus; and the ball, *c*, of the stem, *c d* (in which is a hole

capable of allowing the stem, *a b*, to slide freely within it), is brought into contact with the os, which, when the battery is connected (one pole to each stem), completes the circuit; thus a current can be transmitted longitudinally with little action on the neighboring parts. In cases of flexions and versions, I consider this method superior to any other; and in post-partum hæmorrhage, where we want to produce powerful contractions, the advantages are apparent.

As regards the tension of the current necessary in any given case, it is impossible to give more than general directions. If used for homœopathic purposes, currents which are barely perceptible will suffice. If our object is to promote vigorous contractions, as in obstetric cases, etc., strong currents with rapid intermissions only are effectual, care being of course taken not to overfatigue the organ by too prolonged applications. In these cases it is better to make frequent short applications resting between, and imitate the natural uterine contractions as much as possible.

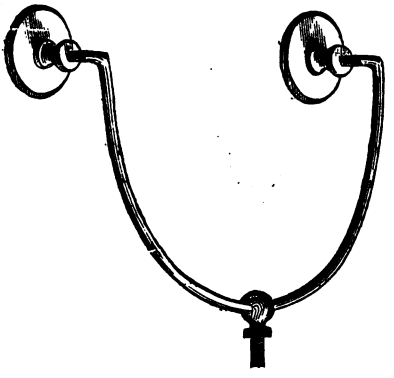
Vagina.—Either current may be applied to the vaginal canal, by electrode (Fig. 19). Having selected the battery pole we intend to use, arm it with the electrode, lubricated with soap and water (*not oil*, for obvious reasons), and insert it as we would an ordinary cylindrical speculum, completing the circuit by a broad rheophore placed on the nates. The vagina is very sensitive to either form of electric current, especially along the urethra. Indeed, it is often well to have the upper part of the instrument, where it comes in contact with the urethra, insulated, so as to be able to act upon the rest of the vagina without the urethra being affected. In using the galvanic current, care should be used not to electrolyze the mucous membrane, which here as elsewhere is liable to happen through careless or ignorant manipulations. An electrode large enough to fill the canal, and so obliterate the rugæ, is requisite; so it is necessary for the operator to have several sizes.

FIG. 19.

Ovaries.—These organs are accessible to electrization by placing moistened sponge electrodes on the skin directly over them, one from either pole; but a better way is to use a bifurcated electrode (Fig. 20), armed with broad sponge-heads. One of these heads being placed over each ovary, the circuit is made by a sponge from the

second pole placed on the sacrum. The patient must lie on the back. Strong currents are well borne in this region; but we must at the same time recollect that electrical treatment is not a question of how much electricity the patient will tolerate, but how little will cure. As a general rule, however, it may be stated that a stronger

FIG. 20.



current is necessary here than is required in electrizing the other organs. This, of course, we would infer when we take into consideration the greater resistance the current has to travel through, which may be considerably greater in some cases than in others from excess of adipose tissue.

STOMACH.

As we have elsewhere shown, the stomach, liver, lungs and heart are affected by electrization of the pneumogastric nerve. They can, however, be acted upon directly by passing a current through them.

The mode of operating on the stomach is by an electrode like Fig. 1, pressed upon the pit of the stomach, and the second electrode (a similar one) on the spine opposite, or in a way which is now exciting some attention in Europe, and first suggested by Dr. Kussmaull. The patient having filled his stomach with fluid, an electrode made like an œsophageal bougie, active only at the tip, is passed through the œsophagus and into the stomach, so as to make contact with the fluid; the second pole is placed outside on the skin

over the stomach. The faradic current is generally the form required.

LIVER.

There is very little skill required to pass a current through this viscus. All the operator needs to know is the anatomical site of the organ, and how to hold a pair of broad sponges so that the current may pass through it as nearly transversely as possible, and not to use a current so strong as to produce pain. The galvanic current is seldom needed.

INTESTINAL CANAL.

It is often necessary to faradize the intestinal canal, and there are many ways of effecting it. One way is, as proposed by Dr. Leroy,* to insert the rectal electrode, Fig. 12, well within the sphincter, and place the other electrode, Fig. 7, in the mouth. This method still has its adherents, but it has been very generally abandoned, and properly so, as a current passed in this way acts much more violently upon the nervous centres than upon the intestinal canal. A second method is to use a pair of broad electrodes on the abdomen, and move them from place to place as the operator considers necessary, or one electrode being fixed on the spine, the other is caused to move over the surface of the abdomen.

The most effective mode of operating is to insert an olive-tipped rheophore well within the rectum, and complete the circuit by an extra large flat sponge rheophore placed over the bowels, which may be moved from place to place as one part becomes sufficiently acted upon. The patient, of course, should lie directly on the back. Should we wish to concentrate the action of the current in the rectum, we can do so, to a great extent at least, by one electrode being placed upon the sacrum, or on the nates, and the other in the rectum.

It is almost needless to say that in all cases requiring the insertion of an electrode into the rectum, that the bowel should previously have been emptied of its contents by an enema of tepid water.

LARYNX, PHARYNX, ETC.

To pass a current directly through the larynx is no very difficult matter; it is merely necessary to complete an electric circuit by placing

* Localized Electrization, Duchenne, p. 105.

an electrode upon each side of the thyroid cartilage. Such a method is seldom called for therapeutically, and even mild intensities transmitted in this way are exceedingly painful, and the adjacent tissues are much more affected than the cartilages or internal muscles of the larynx, as when the current has the choice of several conductors to complete its circuit, it invariably chooses the best, and the larynx being a very poor conductor, and the areolar and muscular tissues surrounding it very good ones, it stands to reason that almost all the force of the current is expended on these latter.

In paralysis of any of the muscles or nerves of the larynx, these parts need to be electrized separately, and with just as much precision as is bestowed on paralysis involving other parts. The skill necessary for such an operation may not be at first sight apparent, but if we reflect a moment on the anatomy, we recognize at once that these parts cannot be thoroughly electrized without proximate contact with the rheophore, that to make that contact it is necessary to introduce the electrode through the mouth and pharynx, and that in order to see that the nerve or muscle is actually acted upon, it is necessary to use the laryngoscope. Hence a thorough knowledge of the anatomy of the part is necessary. The operator must be an expert laryngoscopist, so as to be able to use the mirror with his left hand, leaving the right hand free to manipulate the electrode, battery, etc., and he must also be a practical hand in administering electricity in this way, as no patient will submit to have the fauces, root of the tongue, etc., tickled with instruments by a bungler. Ziemssen (to whom the profession is indebted for what is known of electrization of the larynx) says: "The isolated excitation of the laryngeal muscles from the pharynx is at first attended by great difficulties as well for the operator as the subject. For the first, rapidity in the introduction of instruments, without unnecessarily touching the root of the tongue or fauces, complete knowledge of the anatomy of the parts, with special reference to the objects of the procedure, steady and certain holding of the electrode in the right place, and above all patience are required, etc., etc."

The ordinary method of operating is to fasten the broad sponge rheophore, well moistened, upon the back of the neck, and apply McKenzie's electrode (which is nothing more than a small metallic ball at the end of the insulated wire, fitted into an ordi-

nary interrupting handle), to the muscle or nerve to be electrized, making the application before completing the circuit, which latter is done by pressing the forefinger on the button.

The *arytenoideus* is the easiest muscle to affect. It is merely necessary to place the little ball in contact with the posterior part part of the arytenoid cartilage and complete the circuit.

The *crico-arytenoideus lateralis* is made to contract by the contact of the tip of the electrode at the bottom of the pyriform sinus, at the same time touching the outer margin of the cricoid cartilage. It is a difficult matter to accomplish, even by an expert.

The *thyro-arytenoideus externus* may be reached in the pyriform fossa, by pressing the ball downwards, inwards, and forwards; this also affects the *thyro-arytenoideus internus*. Both the *thyro-arytenoidei interni* can be reached by placing the ball on the vocal cords during an inspiration.

The *crico-arytenoideus posticus* can be acted upon through the pyriform sinus, by pressing the ball of the rheophore backwards and downwards.

The *thyro and aryteno-epiglottidean muscles* may be made to contract by pressing the ball of the rheophore at the sides and base of the epiglottis.

The only muscles of the larynx that can be affected electrically by rheophores applied to the skin are the crico-thyroid. These can be excited by two small sponge rheophores, like those used for the sympathetic, placed one on each side of the conoid ligament.

The *mucous membrane of the pharynx* may be galvanized with the same electrodes, but it is better to have the internal electrode armed with a larger ball, which can be moved from place to place on the mucous membrane, or held firmly in one spot, as the operator thinks most suitable for the disease he happens to be treating. The circuit is usually completed in the manner described for the larynx. Any of the pharyngeal muscles may be affected by direct contact, according to their anatomical site, care being taken to place the electrode as near the middle of each muscle as possible.

In all these delicate operations mild currents only are necessary, as even medium intensities sometimes produce hyperæmia, and even inflammation of the delicate mucous membrane, not to speak of the aggravations which may occur of the symptoms we seek to relieve.

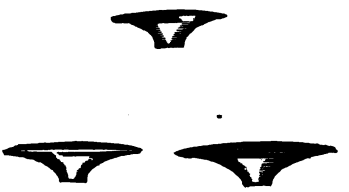
An approximate average dose would be, of the galvanic current, seven or eight volts, and of the faradic such a strength as will produce slight contraction of the orbicularis palpebræ, which the operator had better first test on himself.

SKIN.

It is sometimes necessary to localize the action of the current as much as possible in some particular part of the skin, without allowing the current to act upon the subjacent structures. In order to do this the skin must be thoroughly dried (Duchenne suggests the application of a powder made of rice starch or lycopodium for the purpose). Dry metallic rheophores are then to be applied and moved lightly over the part intended to be acted upon. Rheophores may be made of such a shape as will suit any location. (See Figs. 21 and 22.) The metallic brush-electrode is a very useful form, especially when we wish to act on any part covered with hair. Whatever variety of shape we use, the poles should be approximated as

FIG. 21.

FIG. 22.



much as possible without touching. The faradic is the form of current to be used in most cases, and must be a strong one to overcome the resistance of the dried epidermis, which is very great. In using the galvanic current great care must be taken not to destroy the skin by electrolysis.

NERVES AND MUSCLES.

There is no department of medicine or surgery in which a thorough knowledge of anatomy is so essential as in operating on the various nerves and muscles of the body with electricity. If a patient is incapable of raising his arm to a right angle from his side (no traumatic lesion being present), we are told that he has paralysis of the deltoid muscle, and that the faradic current is the remedy. Now what is the use of knowing this, if we do not know the exact location, origin, and insertion of the deltoid, and its relations with surrounding parts? Again, a patient is suffering from neuralgia, and we expect that a mild galvanic current applied along the track of the affected nerve, or electro-puncture of the nerve itself, will give speedy relief. How are we to carry out this treatment if we do not know exactly where the nerve is located, and yet, how often do we hear physicians order electricity to be applied to a paralyzed or neuralgic patient, by a nurse, or some old woman, who does not even know what the word anatomy means, would not know a nerve from a muscle, and a knowledge of electro-physics, technical skill, or dexterity in manipulation of instruments, is, of course, out of the question. Now the physicians who order electricity to be used in this scientific manner are the very ones who will tell you: "They don't believe in electricity; tried it over and over again, but never saw it do a case any good yet." No, and they never will. Electricity must be used scientifically in order to do any good. In order to affect a nerve electrically, the best way in my mind is to apply a moistened sponge-electrode as near the origin of the nerve as possible, or to a plexus, forming the circuit by another sponge-electrode, placed either so as to cover the greater part of the ultimate ramifications, or else on the trunk of the nerve in some parts of its course; or two electrodes may be attached to one pole, one of which may be placed on the spinal origin of the nerve, and the other on a plexus, while the circuit is completed by the electrode from the other pole being placed over the part supplied by the nerve. As regards the strength and form of current to be used, we must be guided by the disease we are treating, and the effect to be produced, the condition of the nerve, location, etc. For instance, in treating neuralgia, only very mild currents should be used, generally the

galvanic; certainly, beginners should always try first a mild galvanic current, as they are less liable to produce aggravation than with the faradic. Resistances should always be included in the circuit in commencing a seance; they must be gradually removed. The galvanic current must not be interrupted. In paralysis a stronger current must be used; it must be interrupted so as to produce visible contraction of the muscles supplied by the nerve at each closure of the circuit. In treating paralysis a good method is to place one pole on the trunk or origin of the nerve, or plexus, or, if we wish to confine the action to any one muscle, on the point where the nerve enters the muscle, and the other on the affected muscles, in *rotation and separately*. Whatever form of current be employed, slow interruptions only do good. There must be a *perfect pause* between each muscular contraction. This is essential, so as not to fatigue the weakened parts, or aggravate the existing disease. Some authorities lay great stress on the position of the poles; that is to say, whether we should transmit the current in an ascending direction. This is a matter that will be fully entered into again.

In local applications to nerves or muscles, there are certain general rules to be observed:

1. Never produce pain. If you do, be sure you are doing mischief.

2. In using the galvanic current, use cells which generate only a small quantity of current (some modification of Daniell's are best), otherwise in cases requiring rather long seances electrolysis of the skin may take place.

3. In any case of paralysis, where one form of current produces contraction and the other does not, the current which visibly affects is the one to use.

4. Always note the dose *by the galvanometer*, as well as by the number and kind of cells.

5. There are certain locations in which only the very mildest intensities are tolerated, viz.: the forehead, the eyelid, sternum, crest of tibia, angles of scapulæ, the clavicle, and positions where the bones are only sparingly covered by muscle.

6. Never use a current of sufficient intensity to produce any of the pathogenetic effects, and if after any one seance the patient should complain of any of these symptoms, use a weaker intensity at the next treatment.

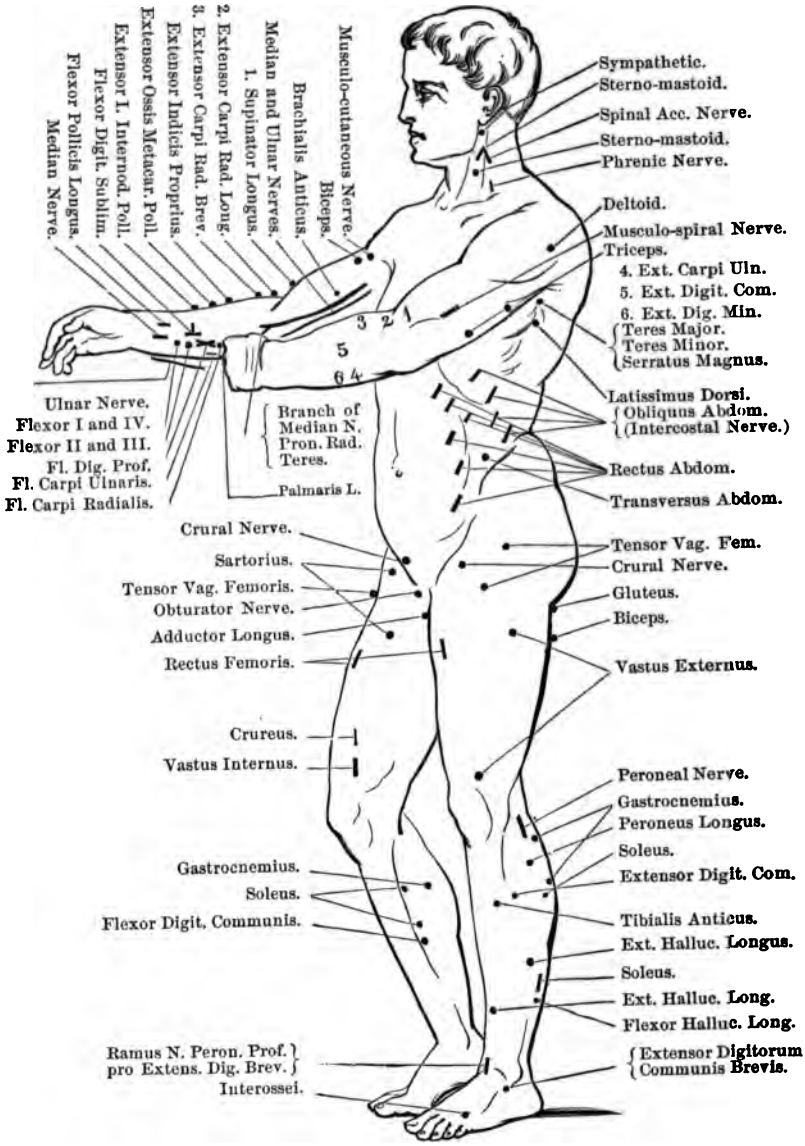


FIG. 23.—MOTOR POINTS OF TRUNK AND LIMBS.

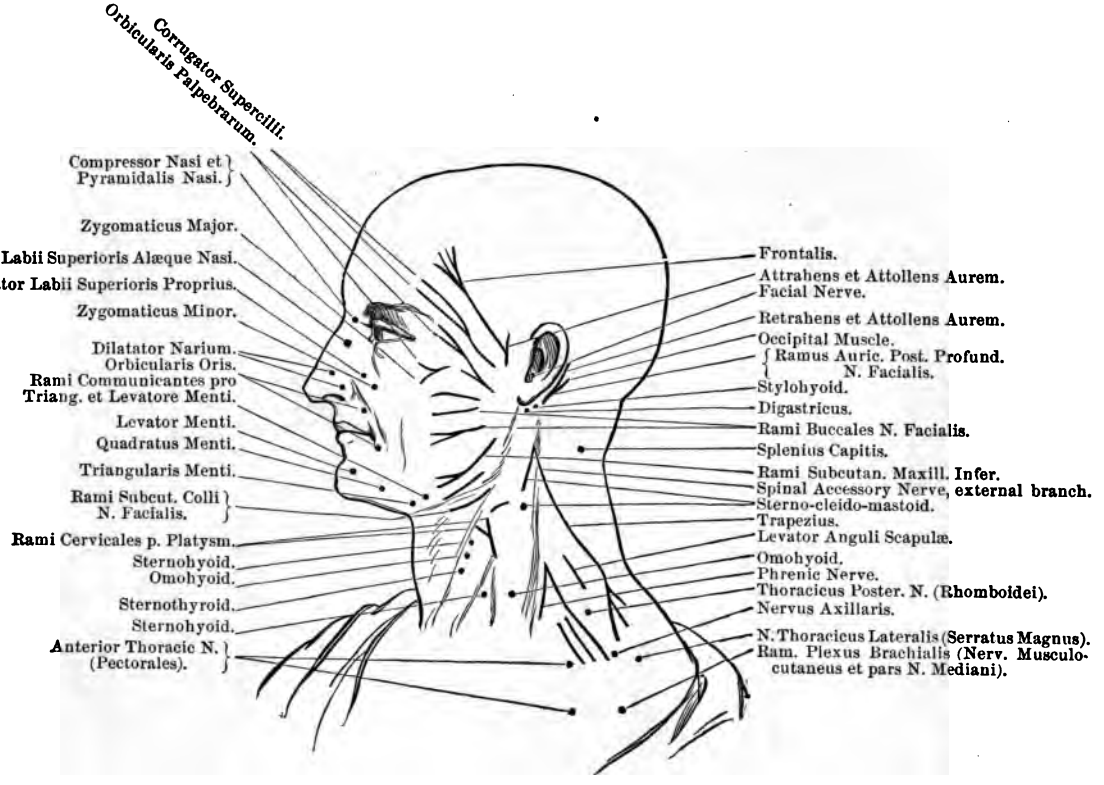
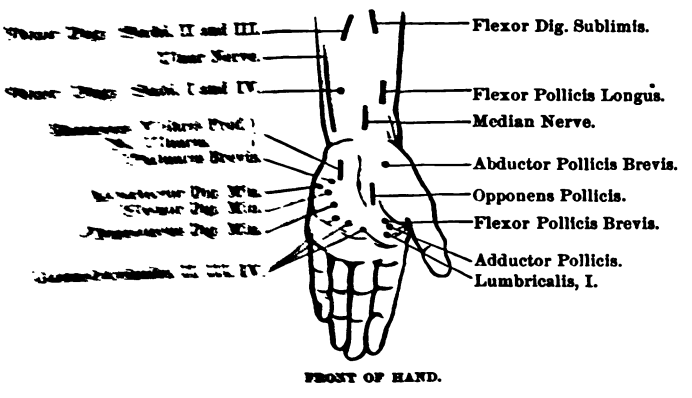


FIG. 24.—MOTOR POINTS OF FACE AND NECK.

In acting upon any muscle, use an electrode of sufficient size to cover the greater part of the fleshy part of the muscle, and plant it firmly as near the centre as possible, always avoiding the tendons.

Some authorities use the unipolar method, which consists in acting upon the nerve or muscle with one electrode, while the other is placed at what they term an indifferent part, for instance to the feet, gluteal region, in the hands, etc. This mode robs the operation of all accuracy, as it not only introduces into the circuit an incalculable amount of resistance, which it takes an unnecessary amount of current to overcome, but it also affects parts of the system which there is at least no necessity for doing, except in parts where there is no room for two electrodes, as the muscles of the larynx, etc.

FIG. 25.



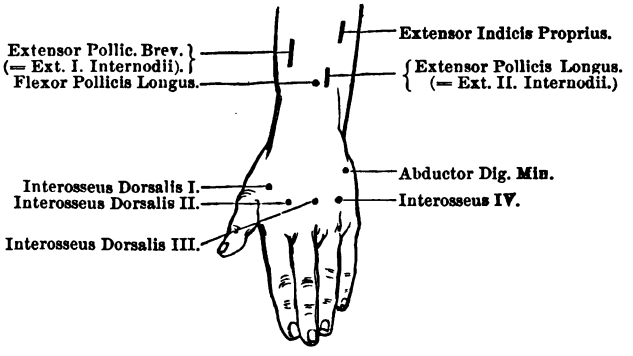
FRONT OF HAND.

Figures 23, 24, 25, 26, and 27, taken from Lincoln's *Electro-Therapeutics*, show the *points d'election* of almost all the external muscles of the body, with the exception of the two points given for the sartorius, which are different from the directions laid down by Ziemssen, and those of Duchenne, and give the student of electro-therapy a better idea of their location than any mere verbal or printed description.

It will be observed that I have laid great stress upon the use of interrupted currents and the production of contractions in the treatment of paralysis. This corresponds to the directions laid down by Ziemssen as well as to the results of my own individual experience. It is but right to add, however, that some of the most

recent authors, among whom I may mention Benedict,* claim to have had good results from continued applications of imperceptible uninterrupted currents.

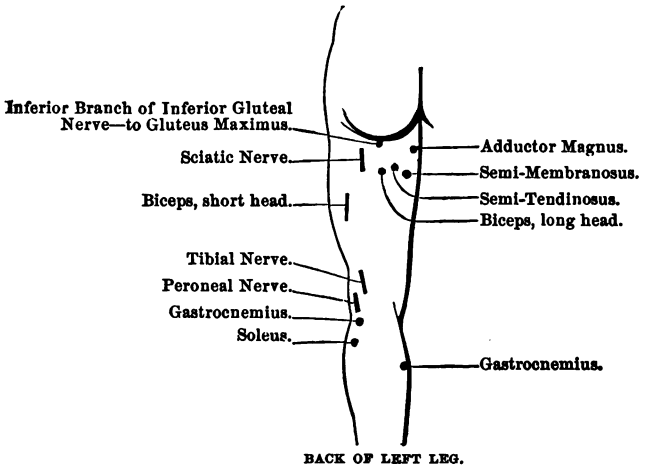
FIG. 26.



BACK OF HAND.

Latterly I have experimented somewhat in this mode of treatment, but the results are not yet sufficiently decided, or my experience suf-

FIG. 27.



BACK OF LEFT LEG.

ficiently matured to hazard the expression of an opinion as to its positive value. The current may be interrupted either by an automatic

* See Ophthalmic Review, No. 6, page 143.

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are produced under closure of the cathode than of the anode. This latter is true also of the faradic current. Therapeutically I have not found it of much importance in which direction the current flowed, as long as it was applied to the proper part, in a suitable dose, and that the symptoms called for it homœopathically. I have cured many cases by the current being transmitted directly, and many similar diseases by an inverse current, and others again by an alternation of direction. Of the cases quoted in this volume some were cured by one method by one authority, and by the other method by others, and in some of the cases no attention was paid to the direction of the current, while in others it was emphatically expressed that there was no perceptible difference in the result whether the current travelled from centre to periphery or from periphery to centre. No matter in which direction the current flows, we can produce or allay pain; we can produce or cure muscular spasms, or paralysis, hyperæmia, hyperæsthesia, or any of the other well-known symptoms of this therapeutic agent. I know that in expressing this opinion I am pitting myself in direct opposition to many of the best authorities on electro-therapeutics of the old school; still, if I can cure cases in which they recommend the use of the ascending current by the descending, and *vice versa*, and similar cases by an alternation of the methods, I certainly have good grounds for my conclusions, and I think owe it to my readers to express them, being at the same time perfectly willing that they should take my opinion as the result of the experience of one man, in opposition to many, and test the matter fully for themselves, before deciding who is right and who is wrong.

Of the uses of the commutator or rheotrope, all I can say here is that by the swift reversal of direction of the current, violent muscular contractions are produced, and many of the pathogenetic effects of the galvanic current increased. I have used it considerably for the purpose of producing muscular action to break up adhesions, but seldom have required it for purely therapeutic purposes.

PART IV.

CHAPTER XX.

USES OF ELECTRICITY IN OBSTETRICS.

BESIDES its uses as a homœopathic remedy, electricity is serviceable in many cases, on account of its chemical, mechanical, absorbent, and other physiological effects; for example, it is used in surgery to destroy by its chemical action morbid growths, to promote the absorption of fluid accumulations, to break up adhesions, and for a variety of other purposes. In obstetrics it is used to produce vigorous contractions of the uterus, either with the design of hastening the expulsion of the fœtus or placenta, or of checking a post-partum hæmorrhage. It is often found useful in increasing the flow of milk, or dispersing a mammary abscess, and in resuscitating a partially asphyxiated fœtus. It is also used in virtue of its capability to produce muscular action, in keeping up artificial respiration, in the case of drowned persons or persons poisoned by noxious gases, etc. We now, however, have to do with its uses in obstetric practice.

The conditions requiring the use of electricity in labor are:

1st. Inertia. The pains suddenly cease after having been sufficient, or the pains are sufficient in frequency, but not strong enough.

2d. A too long retained placenta.

3d. Any case where it is necessary to hasten the birth of the child, as puerperal convulsions, etc.

4th. Post-partum hæmorrhage.

It seems almost unnecessary to add that in any of these conditions, where there is great mechanical resistance to the free passage of the child into the inferior strait of the pelvis, such as malposition, narrowness of the pelvis, or when the head of the child is too large or too unyielding, rigidity of the os uteri, etc., electricity should not

be used until all the impediments to free exit of the child have been overcome.

To illustrate the proper method of operating, we will suppose a case: The patient, a multipara, has been in labor for several hours, the pains have been regular in frequency and strength, the os uteri is fully dilated, or nearly so; it is at least dilatable, and the pains suddenly cease, from some unascertainable cause. We have tried all the ordinarily indicated remedies, and failed. This is just the case for electricity, and I don't think I extol it too highly by saying that in such a case it will never disappoint us. The patient should be placed on the back and a cup-shaped electrode attached to one pole of an ordinary induction machine should be introduced into the vagina, placed in contact with the cervix, and held there by an assistant. The broad sponge electrode should now be moistened, held firmly on the abdomen at a point corresponding to the fundus uteri. The current may now be allowed to flow, commencing with a very weak current, and gradually increasing the strength, until strong bearing-down pains are felt. After the pain has continued about as long as natural pain under the circumstances would do, stop the current and allow a period of *total repose*, and thus imitate nature as nearly as possible, by producing contraction and intermission, until the close of the labor. Of course, if during that time the natural contractions spring up of themselves, we have no further necessity for continuing faradization. The same method may be used to hasten the expulsion of a retained placenta. The galvanic current is never indicated.

In cases of post-partum hæmorrhage, the placenta having been removed, the method of procedure should be somewhat different. A ball electrode (as large as the uterus will admit) should be introduced into the cavity of the uterus, to the fundus; the other electrode (of suitable shape) applied directly to the cervix; the faradic current is introduced so as to complete the circuit. It makes but little difference in which direction the current travels, but it should be of such a strength as to cause the organ to contract vigorously, until it feels like a hard ball when the hand is placed on the abdomen; then the current should be diminished gradually, but the electrodes should not be removed from their places until all signs of hæmorrhage have ceased; so that in case of a repetition of the flow,

the current can at once be called into action without unnecessarily disturbing the patient. I know of no remedy that will control post-partum flowing that is at all comparable with the faradic current. Dr. Alexander Murray,* of this city, states that he obtains good results both in cases of inertia previous to delivery and in post-partum flooding by the use of the faradic current transmitted through the uterus transversely; that is, one pole is placed on the sacrum and the other on the abdomen.

In cases where the secretion of milk is deficient, or even absent, faradization of the breasts is a remedy that will surprise those unacquainted with its action. The case following is reported by Dr. Skinner, of Liverpool, and quoted by Althaus.†

CASE XLVII.—"In August, 1861, he was consulted by a lady on account of vaginal irritation and other morbid symptoms resulting from anæmia. The lady had lately been confined of her fifth child, and she was at the time suckling her infant. She was ordered moderate doses of tincture of iron thrice daily, but this medication was followed in a few days by a complete stoppage of the milk in both breasts. The right breast had never been used for suckling since an attack of mammary abscess some years before, and he therefore faradized only the left breast. At the time of the application, the patient felt a distinct sensation as of a 'rush of milk to the breast.' On the 16th she reported that within a few hours of the faradization, a copious supply of milk was established in the left breast. He was then asked by the lady if he could do any good to the breast which had been so long useless as regards the function of lactation. He made the attempt, having little faith in the wished-for result, but was agreeably surprised to find that after two sittings, of little more than five minutes each, the right breast became as well supplied with milk as the left." Those of my readers who never have used electricity in their practice, will think perhaps that these reports are somewhat overdrawn, and will perhaps be only too ready to infer that because they do not succeed with drug remedies, that electricity is not any more to be depended upon. This case of Dr. Skinner's is only what is repeated every day, and corresponds with

* Beard & Rockwell, op. cit., p. 662.

† Op. cit., p. 679.

several cases occurring in my own practice. The faradic current is all we need in these cases. Large cup-shaped electrodes lined with flannel, thoroughly moistened with hot water, and applied one to each breast for several minutes at a time, is the most convenient mode of treatment. It requires but little skill to accomplish this; any intelligent patient may be taught to do this herself, once or twice daily, and so save the physician much time and trouble. Only currents of mild intensities are needed. In the incipient stage, a mammary abscess may be dispersed by a like procedure.

For the purpose of establishing the respiratory function in a newly born infant, the faradic current may be successfully used. If the operator is sufficiently skilled to place a small sponge rheophore upon the phrenic nerve, in such a position that the pneumogastric is not included in the circuit, this is perhaps the most scientific mode of procedure. The other pole should be moved about over the lower part of the præcordial region. Only mild currents should be called into action. But in case the operator should not be able to trust his skill, respiration may often be established by passing a faradic current in any direction through the walls of the chest, moving the electrodes, which should be broad, from one place to another.

These general directions are also applicable to the resuscitation of drowned persons, or patients poisoned from noxious gases, ether, etc.

PART V.

CHAPTER XXI.

ELECTRICITY AS A MEANS OF DIAGNOSIS AND PROGNOSIS.

SIDE by side with the stethoscope, urinometer, laryngoscope, dynamometer, sphygmograph, etc., stands the electric battery, to aid the physician in forming a correct opinion as to the nature of the malady he is about to deal with. It is used to distinguish between apparent and real death,—between feigned and real disease,—as a means of differential diagnosis in obscure aural affections, to distinguish between central and peripheral paralyses; to ascertain the exact difference of temperature between a diseased and a healthy part. In cases of gunshot wounds, to find out the exact location of the bullet.

We will take these up in their order. In the year 1797 Valli proposed the use of electricity as a test in cases of apparent death, and he is generally supposed to be the first who used it for this purpose. There is no doubt, however, that it had been used before his time. Althaus* quotes from a paper written by Drs. Behrend and Creve, showing that they had used it at least as early as 1792.

It is the only positive test, taken *per se*, we have in cases of trance simulating death, and can be relied upon in every instance. If in any doubtful case the muscles of a body contract under the stimulus of the faradic current and retain that contractility for four hours, there is no doubt the person is alive; but if on the contrary the muscles at first contract and then the electric irritability gradually diminishes and finally disappears, we may give our opinion without hesitation that death has taken place.

FEIGNED DISEASES.

For the purpose of exciting sympathy, extorting charity, evading work, living on the funds of benevolent societies, as well as for

* Op. cit., p. 463.

Various other reasons, diseases are often feigned, and sometimes so well feigned as to puzzle the most able physician. There are few practitioners who have not at one time or other met with such cases. In most instances electricity is not required for the diagnosis; in some, though it furnishes a ready means of detecting a malingerer, it is not the only test, and in others it has to be relied upon entirely.

Feigned Epilepsy.—Formerly this disease was imitated much more frequently than it is at the present day. Indeed, it was no uncommon occurrence for a tramp to fall down in a market-place, or wherever he could secure a throng of sympathizing spectators, foam at the mouth and go through a programme of the most lively contortions, representing muscular spasms, and use these exhibitions as a means of livelihood, filling his pockets from those of the sympathetic but too credulous bystanders. In such a case the faradic current made to act upon the forehead, or crest of the tibia, by means of the wire brush electrode, is a most powerful means of diagnosis, besides being a most forcible persuader to the patient of the error of his ways if the disease is feigned. If the disease is real, the action of the current, of course, is not felt, and the fit goes on as usual; but if assumed, the pain of the operation is so great the will of no individual is strong enough to withstand it. The only bad result that is liable to follow such an application, is the amount of swearing and bad language that is sometimes unintentionally evoked.

Feigned Paralysis.—This is much more commonly pretended than the last mentioned. In any doubtful case, if the muscular contractility be perfect, after the patient has complained two weeks, we may always conclude that the person is an impostor. I now speak of peripheral paralysis, as the class of persons who would lend themselves to such impositions seldom have medical knowledge sufficient to imitate a case of hemiplegia, or cerebral paralysis; and should such a case occur, it can readily be detected by the history of the case and the symptoms, without the use of electricity. In paralysis of sensation the application of the wire brush over the part in which the anæsthesia is complained of produces no pain if the disease be real, but if assumed (as it is sometimes by sailors or soldiers), the pain is such that they would much sooner go on duty than submit to a repetition of the treatment.

ELECTRICITY IN DIFFERENTIAL DIAGNOSIS.

For the purpose of deciding whether a paralysis is cerebral or peripheral, it is only necessary to faradize the affected muscles and compare the strength of the contractions produced with that of the healthy limb, or where both limbs are affected, with some healthy muscles of about the same size as those affected. If the paralysis has existed ten days, and the muscular contractility be perfect or nearly so, we may conclude that the lesion is central. If, on the contrary, the muscles do not respond to the stimulus of the faradic current, or contract feebly, we may decide that the difficulty is peripheral. To this rule I must make one exception, and that is the form of paralysis known as rheumatic. In this affection the electro-muscular contractility is increased, instead of diminished, under both currents. Indeed in this disease I have seen the rectus femoris of the affected limb painfully and violently contract under five volts of the galvanic current; while the same muscle of the healthy thigh required a tension five times as great to produce the same effect.

However, as a general rule, we may state that in peripheral paralysis the muscular contractility to the faradic current is lost early, while in cerebral paralysis it is not. In rheumatic paralysis the contractility to both currents is always increased, hence we have in electricity a ready means of differential diagnosis in these diseases. In saturnine or lead paralysis, as has been already mentioned, the extensor muscles of the forearm are the ones first attacked, the flexors are always spared, and the disease never appears in the lower extremities. It may appear from this that it must always be an easy matter to diagnose a lead palsy, taking into consideration these symptoms, and the blue line on the gums, and other manifestations of the poisonous action of lead upon the system. Well, so it is, in a well-marked case which has existed for some time; but in an incipient or mild instance, before the voluntary motion is entirely lost, these characteristics are often so indistinctly marked that we must use more accurate means of discrimination. If in a suspected case we find the farado-muscular contractility of the extensor muscles of the forearms (both) diminished, and the flexors perfect, and also that the disease has not attacked the lower

extremities, we are justified in assuming that paresis or paralysis is due to the presence of lead in the system.

Duchenne remarks, in his work so often heretofore quoted, that in hysterical paralysis the muscular contractility under faradism is always perfect, while at the same time the muscular sensitiveness to the same current is diminished or wholly lost. Althaus* says: "In paralysis from disease of the antero-lateral columns of the spinal cord, the electro-muscular contractility is either diminished or gone, according to the degree of the severity of the affection. This constitutes in certain cases a good test for distinguishing between disease of the antero-lateral and posterior columns of the cord. In progressive locomotor ataxy, which affects chiefly the posterior columns, the muscular response is generally quite normal, although the bulk of the muscles may have notably decreased, and they may refuse to obey the orders of volition."

As regards prognosis in peripheral paralysis, we may accept it as a rule that, provided the cause be removable, the length of time required to complete restoration of muscular function varies in the direct ratio of the amount of atrophy and loss of electric contractility; that is to say, if in any case there be but little atrophy, and the muscles respond somewhat to being stimulated by the faradic current, we may reasonably expect to bring about a cure in a comparatively short time. If, however, on the other hand, the muscles are much wasted, the disease has existed a long time, and the muscles refuse to respond to the application of either kind of current, the case, though possibly and probably curable, requires long treatment and a guarded prognosis. In cases of complete obliteration of muscular tissue following atrophic paralysis, it is of course unreasonable to hope for any improvement.

ELECTRO-DIAGNOSIS OF OBSCURE AURAL DISEASES.

The use of what is known as Brenner's formula is now admitted by most of the prominent electro-therapeutists to be one of the most powerful aids to diagnosis of certain diseases of the ear. I say by most electro-therapeutists, as up to the present the truth of the

* Medical Electricity, p. 449.

formula was bitterly denied by many of Brenner's opponents. These opponents are gradually becoming converted, and now very few, if any, remain. Why its correctness should ever be questioned by any one who has thoroughly and honestly tested it, I am at a loss to discern. The formula is nothing more than the galvanic reaction upon the healthy auditory nerves, and may be briefly stated thus:

1. On closing the cathode a ringing noise is produced in the ear, which is expressed by the formula, Ca.Cl.S.

2. The cathode opening produces no perceptible effect, Ca.Op.O.

3. The closure of the anode produces no effect, An.Cl.O.

4. The anodal opening, with a current of high intensity, produced a slight ringing noise, An.Op.S.

5. Cathode duration. Sound produced at closing diminishes, Ca.D.S>.

6. Anode duration, nothing, AnD.

Where the current is transmitted from one external auditory meatus to the other—say the right ear being under the influence of the positive pole, and the left under the negative, and both ears perfectly healthy, we get the following reactions at the opening and closing of the circuit:

	Right ear (anode).	Left ear (cathode).
Cl.	O.	S (loud).
Op.	S (weak).	O.
D.	O.	S>.

Now, Brenner teaches that any departure from this formula is caused by some aural disease, and even points out the kind of changes in the formula that different diseases produce; for instance, in simple hyperæsthesia of the acoustic nerve of short standing, all the symptoms produced by the current are increased. The sound produced under the duration of the cathode, instead of gradually diminishing, continues with the same force as long as the current is applied; or the sounds, instead of being musical, change their character to that of a buzzing, hissing noise. In torpor of the auditory nerve it requires a high intensity of current to produce the sounds, the tension necessary varies in proportion to the amount of the torpor. Indeed, in some cases of this difficulty it is impossible to

call forth the sounds at all, as, when the current is increased beyond a certain point, the action on the brain becomes too intense, and the symptoms detailed at page 18 become so prominent as to necessitate a discontinuance of the application. Dr. H. C. Houghton has written a valuable paper on this subject, entitled "Electricity as a Means of Differential Diagnosis in Lesions of the Middle and Internal Ear," which is published in the twelfth volume of the *New York State Transactions*. In this article the Doctor gives an account of the cases examined, all the detail of the changes of formula, and treats the subject generally carefully or with precision. It is well worth the perusal and study of those who wish to give their attention to this branch of medicine.

BECQUEREL'S DISKS.

These little instruments are nothing more than two thin disks of copper, about the size of a cent, soldered on to rods of bismuth, which are contained in a pair of hard rubber tubes, and attached by wires to a delicate galvanometer. They are used to ascertain the difference of temperature between one part of the body and another. We will suppose, for the sake of illustration, one of the lower extremities is paralyzed; we place one of the disks on the affected limb, and the other on the healthy one, and if there is any difference in the temperature, the needle of the galvanometer is deflected accordingly, the amount of deflection varying in the direct ratio of the difference of temperature, which may be ascertained even to the one-hundredth part of a degree. If there is no difference of temperature the needle remains stationary. When used from day to day they are a certain guide as to the amount of improvement that is taking place in the affected limb, and form an important means of prognosis.

THE ELECTRIC PROBE.

This instrument is used principally in the case of gunshot wounds, to ascertain the exact location of a bullet; it is equally applicable, however, in discovering the presence of other metallic missiles. The probe consists of a pair of wires, insulated from each other by a strip

of hard rubber or ivory; the tips of the wires, projecting beyond the insulation say about the one-sixteenth of an inch, are in electrical connection with a galvanic cell and electro-magnet, acting on a bell, so that if the extremities of the double probe touch a metallic substance the circuit is completed, and the bell is immediately rung, and so points out the exact location of the projectile. A pair of forceps constructed in a similar manner tells exactly whether a bullet or a piece of bone is seized: as none of the tissues of the body are sufficiently good conductors to suitably complete the circuit, the bell is not rung by the wires coming in contact with them.

PART VI.

ELECTRO-SURGERY.

CHAPTER XXII.

ELECTROLYSIS, ELECTRO-CATALYSIS, ETC.

In almost all the previous works on electro-surgery, the word electrolysis has been used as an indefinite kind of equivalent to represent all the actions of electricity on diseased growths. Such application of the term having led to much confusion, I limit the application of the word in the following pages to its literal meaning as taken from its derivation, ελεκτρον, the synonym for electricity, and λυω, I dissolve; hence, electrolysis means nothing more or less than decomposition of a substance or part by the action of an electric current, just as analysis is used in chemical technology. I do this simply to avoid confusion, and in each instance where electricity is used, I try to convey as distinctly as possible the exact effect which is intended to be produced in a given case, limiting the word electrolysis to represent only the electro-chemical destruction of a part.

When two or more needles, connected with the poles of an apparatus generating a galvanic current of sufficient intensity to overcome the resistance of the circuit, are inserted into living animal tissue, the following results take place, viz.: the bloodvessels of the part become dilated and engorged, producing intense hyperæmia, and the absorbents are stimulated to increased activity. In short applications with weak currents the effect ends here, but should the action of the current be continued, and the tension and quantity slightly increased, the albumen of the part becomes coagulated; and with a still stronger current the water of the tissues becomes decomposed, the oxygen becoming attracted towards the positive pole and the hydrogen towards the negative, to find vent at which the gases bubble violently through the intervening structures, tearing fibre of

muscle, separating cells, nuclei, and filaments, etc., and mechanically destroying anything that may oppose their egress. The salts of the tissues are furthermore resolved into their contained acids and alkalies, the acids being attracted to the positive pole, and the alkalies forming around the negative, where they act as powerful escharotics, producing sloughing. Thus the tissue acted upon is made to destroy itself through its own contained reagents.

The operation thus described may practically be divided into four stages.

1st. The dynamic or absorbent stage, corresponding to what is called by Remak electro-catalysis.

2d. The coagulating stage.

3d. The stage of mechanical disintegration; and

4th. The escharotic stage, or the stage of complete and ultimate electrolysis.

We use the first stage only in the treatment of serous effusions, strictures, watery cysts, etc.; the second stage in the treatment of aneurism, varicose veins, hæmorrhoids, nævus, and other diseases, where coagulation of the contained blood is desired, and where the production of a slough is not intended; the third and fourth stages in growths of a malignant nature, fibrous tumors, polypi, and in any case where destruction of the whole or part of a morbid growth may be necessary.

In this operation the greatest amount of effect produced is in the immediate vicinity of the needles; in very mild currents the cauterizing effect is only produced in the parts directly in contact with the needle; with strong currents the size of the slough depends upon the structure of the tissue, the amount of water and salts it contains, the size of the needle, and the duration of the application. The eschar produced by the positive pole differs essentially from that caused by the negative, inasmuch as the ulcer resulting from the separation of the slough of the first leaves a cicatrix which heals by contraction like that produced by an acid caustic: no such result takes place from the action of the negative pole; on the contrary the cicatrix is soft and pliable.

It is, of course, entirely impossible to obtain purely and separately, the results of any one of these stages *per se;* for instance, in electropuncture of an ovarian cyst, the result aimed at is to produce absorption, and act on the internal part of the cyst so as to destroy its

secreting powers, and so prevent refilling. Electrolysis of the watery parts of the contents must and does take place to a greater or less degree, but it forms no part of the desired effect; and so in operating upon aneurism or nævus though coagulation of the blood is the only thing desired, still a slight eschar around the uninsulated part of the needle is unavoidable. In such an operation it behooves us to make this latter as slight as possible, which *can* be done by diminishing the amount of current used, that is to say, in any operation requiring a cauterizing effect, a large quantity is required. In operations where we simply desire to produce the absorbent or electro-catalytic effect we require tension, but small quantity.

Electro-puncture as thus described is presumed to have been performed with needles made of unoxidizable material. Should the needle of the positive pole be made of material capable of being acted upon by the acids set free at this point, the results are modified in a great degree. For example, suppose the positive needle be made of iron, the needle becomes dissolved by the acids set free, and the phosphate, sulphate, and chloride of iron are formed, principally the chloride. From this fact we would infer that iron needles would be useful where coagulation of blood is the result aimed at. And there is no doubt that they assist in the accomplishment of such a result to a considerable extent.

Suppose we use zinc needles, we have chloride of zinc formed, which is a powerful escharotic, and assists materially in hastening the destruction of morbid growths. I have used these needles with a weak galvanic current and long applications for the destruction of malignant tumors, and believe it to be in many cases the most appropriate treatment. The diseased tissue is chemically dissolved under the action of the current, while at the same time its dynamic action influences the morbid nervous impulse which caused the secretion of the mistaken cells in the first place; and the electro-chemical action of the already disintegrating structure on the needle, forms, molecule by molecule, one of the most powerful escharotics, which destroys atom by atom any of the diseased mass that may possibly escape the action of the current, and not only that, but the chloride acts as a powerful antiseptic on the slough, that otherwise might become offensive before separation has had time to take place, and still further, it certainly hastens that separation. Another ad-

vantage of the operation is, that it is comparatively painless, in some cases entirely so. Electrolysis of the tissue takes place so slowly that the chloride of zinc is also formed slowly, and as it forms, it immediately unites with the tissue that is already half numbed by the action of the current. Very little pain, if any, is produced; in fact, in some cases the strength of the current can be so arranged that no pain is caused. In my opinion this electro-chemical treatment far surpasses ordinary electrolysis in certain cases, where total destruction of the part in as short a time as possible, with a minimum amount of pain, is desired, and where it is not desirable to have an anæsthetic administered, as is generally necessary where electrolysis is quickly performed, especially where total destruction of a growth is the object aimed at.

We will for the present dismiss this question of electro-chemical treatment and return once more to a consideration of the effects of the current as applied with unoxidizable material.

This operation so far we have only considered as performed by the use of needles introduced into the tissues. The same effects in a lesser degree can be obtained by external applications of metallic and other rheophores to the skin, mucous membrane, or denuded tissue, and when we use the current for the sake of its lesser effects, it is frequently applied in this manner.

One of the greatest difficulties in the technics of electro-surgery to the beginner, is to avoid doing too much. The operator must have a battery provided with a Brenner's or other equally accurate rheostat, constant and reliable, capable of giving every variation of quantity and intensity of current. He must be quite familiar with its action, and with the effect each variation is capable of producing on living animal tissue. He must also be able to control the electromotive force to the exact point capable of producing the effect desired, *and no more.* For instance, what could be more deplorable than that sloughing of the urethra should take place, when the effect intended to be produced is merely the absorption of a stricture? Or in operating on a nævus on the face of a young lady, that an eschar should be caused when we merely aim at coagulation of the morbid growth? And yet the slightest overstepping of a scarcely defined boundary will cause just such results. *Better far do too little than too much.*

It is impossible to state with precision the exact quantity and intensity of current to be used, as that depends upon the size of the growth, the density, the amount of watery and saline ingredients contained. This must be learned entirely by experience. We will first take up

STRICTURE OF THE URETHRA

for consideration. In stricture of the urethra, as before remarked, the result desired is the absorption of the stricture, and except in old, hard, cartilaginous strictures all cauterizing effects must be sedulously avoided. The method of operating electrically with a view to causing this absorption is to introduce into the canal an electrode like Fig. 11, about a size larger than the stricture will admit (insulated to the tip), down to the stricture. The electrode in this case must be soaped, not oiled (oil being a non-conductor), for the purpose of lubrication, and to facilitate its introduction. This electrode is to be then attached to the *negative* pole of the battery. The circuit is completed by the broad sponge rheophore moistened with salt and water, and either held in the hand of the patient or placed upon some convenient part. The patient may be operated upon either standing or lying, as is most convenient. As regards the amount of current to be used, the first point is here, as elsewhere, to use as little as will produce the desired effect, and that is best judged by consulting the sensation of the patient. We must avoid all production of pain. As soon as the patient feels the current the intensity is sufficient, and should not be increased beyond this point. I prefer the use of some modification of Daniell's elements, and perhaps I may state as an average that a current from six to twenty of these cells is all that is ever needed. Keeping the electrode pressed in contact with the stricture, but not forced, we generally have the satisfaction, in a few minutes, to find that it slips with facility through. If a second stricture is present, it may be treated in the same way. This completes the first operation, which may be repeated as many times as necessary at intervals of a few days.

It will be noticed here, that I have laid great stress upon the use of the *negative* pole. This is quite necessary, as the use of the posi-

tive easily produces an eschar, which heals by contraction, and so, instead of curing a stricture, will actually cause one, as I shall show by and by.

CASE XLVIII.—Mr. M. J., æt. 40, a strong, robust man, consulted me relative to a stricture of the membranous portion of the urethra, barely capable of admitting a No. 5 bougie. The stricture had been in existence twelve years; it was very irritable, and bled freely on being touched. I passed a No. 5 sound insulated to within half an inch of the tip down to the stricture, and connected it with the negative pole of a small battery, completing the circuit by means of a moistened sponge placed in the groin. I allowed a current from twelve elements to flow uninterruptedly for five minutes, and then reduced the number to eight, which I used for five minutes longer. After the operation I had no difficulty in introducing a No. 7 sound. The patient had some slight pain on urinating for a day or two afterwards, which gradually passed off. The size of the stream of urine increased.

Ten days after the operation I passed an insulated No. 9 bougie into the stricture, and used the current from twelve elements for five minutes as before, the instrument slipping through the stricture without any difficulty. I then withdrew the instrument, and passed a No. 11 electrode, using eight elements for five minutes. One week afterward I passed a full-sized bougie into this patient's urethra, and continued to do so every week for five weeks, when I dismissed him cured.

CASE XLIX.—Captain B., a sailor, æt. 35. Had gonorrhœa several times; found a stricture in the spongy portion of the urethra, capable of admitting a No. 6 sound, and one in the membranous, into which with the greatest difficulty, and after many trials, I succeeded in passing a No. 2 sound. I operated as above, only, of course, with smaller instruments. The stricture in the spongy portion required two operations, and the one in the membranous three. No return.

A number of other cases might be given, but there is such a similarity in their history that a perusal of them would be tedious to

the general reader. There are several cases of stricture operated on in this method reported by me in the *New York Journal of Homœopathy*, August 26th, 1873, p. 277.

There are also some cases fully detailed by Dr. Newman, of this city, in the *Archives of Electrology and Neurology*, vol. i, p. 18.

Dr. Edmund Murphy, of New Orleans, in a private correspondence which I recently had from him, details the following case of stricture *caused by the action of the positive pole* and cured by the negative, of which the subjoined is a synopsis:

CASE L.—J. M. G., 33 years of age, was treated by a physician in May, 1871, for what he supposed was seminal weakness. As far as the patient knew at the time (and he had no reason to suppose otherwise) the urethra was perfectly healthy; no evidence whatever of stricture was found. This doctor treated him by the use of an electrode attached to the *positive* pole of the galvanic battery, inserted into the urethra to about the orifice of the common ejaculatory duct. The current used, being so unnecessarily strong, produced a slough, leaving an ulcer which healed by contraction, and the result was a stricture which almost closed the canal. Dr. M., in describing the condition of the patient when he came to him, says, "That on feeling the urethra externally the hardness of the cicatrix was such that it actually felt as if there was a metallic sound underneath the finger." Dr. M. treated him with a few applications from the *negative* pole of the battery, which completely removed the stricture in a short time.

The advantages of treating strictures by this method are: 1st. There is no tendency to re-formation, even where the current is used so strong as to destroy the mucous membrane, as *the eschar produced by the negative pole never heals by contraction, but is soft and dilatable*, as may be readily seen when occurring on the skin or mucous membrane externally. 2d. There is no hæmorrhage, or very little. 3d. The pain produced is trifling. 4th. There is no surgical shock. 5th. There is no after inconvenience to the patient; and 6th. There is only a short after-treatment required.

Strictures of the œsophagus and rectum may be treated on the same principle as those of the urethra. The method of operating

on the former is fully detailed in the history and description of the following case:

STRICTURE OF THE ŒSOPHAGUS.

CASE LI.—On December 2d, 1877, I was sent for by my friend Dr. Helmuth to see a young lady patient, to whom he had just been called, and of whom he gave me the following history: On the 20th of June, 1877, at Kingston, N. Y., the young lady swallowed a teaspoonful of nitric acid and creosote, a mixture which is popularly known as "Palmer's Vegetable (!) Compound," in mistake for essence of Jamaica ginger. After the acute symptoms resulting had subsided, she discovered considerable difficulty in swallowing; a certain amount of liquid would apparently be swallowed and almost immediately return, to be ejected either through the mouth or through the nose; there was total inability to swallow anything solid. The case progressed so that finally there was no evidence to show that anything whatever passed into the stomach. The girl, of course, became emaciated, and at the time of my visit was exceedingly prostrated, could scarcely sit up, and could make no attempt to walk without assistance. She had subsisted entirely upon injections per rectum since the time of the accident.

On examination of the œsophagus I found that even the smallest bougie could not be inserted through the stricture, which was situated about four inches above the cardiac orifice of the stomach. Above this point the œsophagus was much dilated and pouched. Dr. Helmuth had tried the ordinary rubber bougies of different sizes; so had the other physicians who had attended her during her sickness. They concluded that nothing in medicine or surgery could possibly relieve her, except, as Dr. Helmuth suggested, the stricture could possibly be obliterated by electrolysis. Dr. Hammond, who had previously been called in consultation, gave as his opinion that no power on earth could save her, and did not even suggest the possibility of electrolytic treatment being likely to benefit. Being urged by Dr. Helmuth to undertake the case, and try what electrolysis would do, I reluctantly consented. I used an instrument made with a long insulated stem, having a naked metallic bulb on the tip about

the size of a pea; this I introduced through the œsophagus and down to the stricture, connected it with the negative pole of the Stöhrer battery, forming a circuit by a large sponge rheophore placed on the pit of the stomach. I allowed a current of about ten volts to flow, and after a while the instrument made its way through the obstructed part. About an inch below this I met another resistance; this one was bandlike and elastic to the touch, and after a moment or two yielded to the action of the current. Almost immediately below this I encountered another stoppage; this resisted the action of the current for about fifteen minutes (twenty volts), but finally the electrode passed into the stomach. On ascertaining this I withdrew the instrument and introduced a very small stomach-tube, through which I injected half a pint of milk. I then left the patient. On the next day I introduced the same bougie and repeated the milk injection. The inflammatory symptoms from the application the day before were not serious. Left the tube in for an hour and a half, at the end of which time another half pint of milk was injected.

On December 6th I repeated the electrical operation, as in the first instance, only using a larger bulb, after which I was able to introduce into the stomach a large-sized tube, and through it injected liquid food, such as beef tea, barley water, milk, etc.

On the 10th used electrolysis again, with a still larger instrument; did not operate again until the 22d, when I used an electrode with a cone-shaped tip, almost as large as the normal opening should be, using a rather powerful current, the circuit being completed as in the first instance. The pain resulting from this operation, as well as the inflammatory symptoms afterwards, were much greater than in any of the previous instances. These, however, soon subsided, and on Christmas day the patient had the satisfaction of enjoying a good dinner, which she had not before done since the 19th of June. The stricture not being entirely removed, I operated as before mentioned on the 30th, making in all five electrical applications. After this the patient progressed favorably, and now suffers no inconvenience whatever. In order to prevent a tendency to recurrence, I provided the patient with a full-sized bougie, which she introduces herself occasionally. At my first visit to her, her weight was sixty-five

pounds. On February 1st she weighed one hundred and thirty, and is, as far as it is possible to judge, entirely free from any of the original trouble.

NÆVUS MATERNUS.

In operating upon nævus a number of fine uninsulated needles should be inserted into the base of the growth, parallel to each other, and about a quarter of an inch apart, the number of needles of course varying with the size of the tumor. These should be connected with the battery in such a way that every alternate needle is connected with the positive pole, the remainder with the negative. A mild current should be allowed to flow until the blood in the growth becomes coagulated. This result may be known to have taken place by the tumor becoming hard and inelastic. The needles may be then withdrawn. It is only very rarely that even a drop of blood exudes. As regards the after-treatment, cold-water dressing is the best application.

It will be noticed here that these directions differ from those laid down by most authorities. We find directions in books telling us that the positive pole should be used, and the circuit completed by a moistened sponge rheophore. This method will answer the purpose, but we thereby introduce into the circuit an unnecessary amount of resistance, and are obliged to use a current of greater tension. By utilizing both poles, as in the method just given, we economize our current and operate with more precision.

Case LII.—May, 1873. J. W., a boy, aged 12. Nævus on the lower eyelid. Operated as above indicated by means of two needles, one from each pole of the battery, transmitting a current from five Stöhrer's elements for five minutes. A coagulum formed, which dropped off six days afterwards, revealing a small portion of the nævus that had not been acted on by the current. I immediately performed a second operation, which entirely removed all trace of the growth.

Case LIII.—February, 1874. M. J., æt. 3, was brought to my clinic to be operated upon for a small nævus of the lower lip. I in-

troduced three needles connected with sixteen cells of a Smee battery (equal in electro-motive force to about five Stöhrer's), allowing the current to run steadily for three minutes, when I found the tumor had become sufficiently hard to discontinue the operation. Saw patient three days afterwards; a small, dry scab had taken the place of the nævus. In two weeks there was no mark whatever, nor anything to indicate that there ever had been any abnormal growth.

CASE LIV.—A. T., an infant, æt. four months, was brought to my clinic on October 13th, 1874, to have a nævus removed. The growth was situated on the superior and external part of the scapula, and was about two inches in diameter, more raised above the surrounding skin than the average we meet with. The child being placed under the influence of an anæsthetic by my friend Dr. Searle, I proceeded to operate in the manner before described, a current from sixteen Smee cells being used for fifteen minutes; coagulation took place, leaving only a hardened lump in place of the nævus. Three weeks after the operation there was only a very slight mark left.

CASE LV.—R. W., a boy, æt. 5 years. Nævus of left cheek. Operated on November 29th, 1874. Only a slight scar left, which is scarcely noticeable.

CASE LVI.—January 8th, 1878. O. S., æt. 6. Small nævus on tip of nose. Electro-puncture. Five Callaud cells, one hundred ohms resistance, two needles, one from each pole. Coagulum formed in about five minutes; dropped off in a few days. Entire disappearance of growth. No scar.

CASE LVII.—February 24th, 1878. A little girl, æt. 5. Sent to me by Dr. Belden, of Jamaica, New York, on account of a small nævus on right lower eyelid. It had been very troublesome from its frequently bleeding profusely after being accidentally scratched, or rubbed with a towel. This made the parents very anxious about it, otherwise they considered the mark of no importance whatever. Operated exactly as in the case above mentioned, and with the same result.

CASE LVIII.—N. S. was sent to me, on November 12th, by my friend, W. S. Searle, of Brooklyn, on account of a nævus, situated below the lower eyelid, very much raised, and about the size of a cent. The greater part of it was removed by the operation above described. A small portion remaining was entirely removed by two slight applications, one made on the 20th of the month and the other on December 6th. There was no eversion of the eyelid produced, nor is there now any scar left to indicate that the child ever had anything abnormal there.

As a general rule, it may be laid down that nævi require but one operation to complete a cure. As far as my experience goes during the last few years, only one case in five required a second operation. The advantages of this method of treating nævi are at once apparent. For comparison we will mention the other means by which they are usually treated:

1st. By vaccination, which is only applicable to very small growths, is not always successful, and invariably leaves a visible cicatrix.

2d. By ligature, which always destroys more or less of the healthy tissue, leaves an absorbable slough in contact with the irritant absorbents for many days, which often gives rise to a great deal of constitutional disturbance, and always leaves a permanent scar.

3d. By the actual or galvanic cautery. This method causes an ulcer, which heals by contraction, and, unless the operation is very nicely done, which is not always possible, leaves a hideous mark.

4th. By the injection of persulphate or perchloride of iron. This mode, though less objectionable than either of the three preceding, is not invariably successful, except in smaller tumors. It always leaves absorbable decomposing matter in contact with the congested tissues.

The advantages, then, of treating these cases by electrolysis may be briefly summed up as follows:

1st. In most cases there is no scar left, and, even in the largest tumors, the permanent mark (if any) is comparatively very slight.

2d. There is no constitutional disturbance after the operation.

3d. It is unnecessary to destroy any of the surrounding healthy tissues.

4th. One operation is generally sufficient to remove the abnormality.

HÆMORRHOIDS.

Many authorities report favorably of the treatment of hæmorrhoids by electro-puncture; but, as the result of my experience, I am of the opinion that the amount of inflammation and diffuse suppuration caused by the operation in the loose cellular tissue in the vicinity of the anus, renders it not only objectionable, but an unjustifiable mode of treatment. Consequently, I have latterly entirely abandoned it in favor of galvano-cautery, which gives excellent results. However, this operation will be alluded to again under the proper heading.

ANEURISM.

The effect the galvanic current produces in causing coagulation of blood has been made use of in the treatment of aneurism. There are a number of cases on record, some of them successes, most of them not. With very few exceptions the operations were performed by persons who had very little knowledge of electro-physics, as can readily be seen from the report of the cases. (See Poore's work, already quoted, page 256, *et seq.*) Now, I will say candidly in advance that, clinically, I know nothing of the subject; but it seems to me that a procedure something like the following would certainly be more likely to cure an aneurism than any electrical operation that has yet been proposed.

Soft iron needles, insulated for half their length with hard rubber (Kidder's patent), so as to protect the coats of the vessel from the action of the current, are to be inserted into the aneurism as many as may seem desirable, varying in number according to the size of the aneurism. These needles must be inserted in such a way that the whole of the exposed or active part of them shall be entirely within the internal coat of the sac, as otherwise the coverings of the tumor would be dissolved by the chemical action of the current. The needles are now to be connected with the poles of a battery, generating a current of small quantity and very moderate intensity. The quantity must correspond with the number of needles; that is to say, the greater the number of needles, the larger must be the quantity of current transmitted.

If two needles are used, one of course must be connected to each pole; but if several be employed, only one should be in connec-

tion with the negative, and the remainder with the positive, as the negative is merely used for the sake of completing the circuit, and it is entirely to the action of the positive we trust for the effect in producing the clot, by which we expect to cause obliteration of the aneurism.

Now, from what we have already described relative to the action of the current, we naturally would expect from a procedure like this, 1st. That the blood contained within the sac would become coagulated around the positive needles. 2d. That the salts of the tissues would be resolved into the acids and bases which go to form them. 3d. That the needle or needles attached to the positive pole would become dissolved, and chloride of iron formed, which fact assists materially in furthering coagulation.

It seems to me that if the operation was performed in this way, and the needles left in long enough to become entirely dissolved, so as not to necessitate the breaking up of the clot in withdrawing them, that such an operation ought to prove a success. It must be performed with a very weak current, and applied for certainly not less than two days. In this way a clot is slowly formed, and has a chance to become firm and completely fill the dilatation before the action of the battery is discontinued.

Knowing the strength of the current, the resistance of the circuit, the weight of the needles (that is, of the uninsulated part of them), the atomic valency of iron, and of the anions or acid radicals of the blood, it is simply a matter of arithmetical calculation to find out exactly how long a time it will take for the needles to become dissolved, and for a clot of such a size as we wish to form.

Now I well know the first objection that will be made to such a procedure by those who have a slight knowledge of electro-surgery. It is this: they will say, "What becomes of the gases evolved by the decomposition of the watery part of the blood?" "The trouble heretofore always has been to get rid of the hydrogen." To this I would answer, that in such *very slow action* the gases are evolved at such a *very slow rate* that the animal economy has ample time to get rid of these gases as they are formed. When we consider that it takes just one veber of actual current to dissolve .00142 of a grain of water, and we use a current which will not generate this amount of current

per hour, I do not think there is much danger of sending gas-bubbles through the heart, or otherwise producing trouble by it.

I regret exceedingly, in writing a work of this kind, that I have no cases treated by this method to offer in illustration, but I hope that if I ever should be sufficiently honored to have a second edition called for, to be able to show some evidence in its favor.

VARICOSE VEINS.

It is quite possible to treat varicose veins and varicocele in a similar manner, but the cautery operation, described farther on in these pages, is so efficient and so much more easily performed that it is unnecessary to more than mention this subject, as one can scarcely imagine a case in which obliteration by the cautery is not decidedly the preferable method.

CHAPTER XXIII.

FIBROUS TUMORS.

THESE growths, if superficial, and a total and rapid destruction be desired, may be treated by what I have termed the fourth stage of electro-puncture, or complete electrolysis, by which a slough of the entire growth is produced and left to separate.

If from position or otherwise such a course is objectionable, its disappearance can be caused by producing a slough within the tumor, not sufficiently large, however, to cause its entire destruction, but of such dimensions that will be too large to be readily absorbed. Such a slough will act as a foreign body, and will cause inflammation, followed by suppuration, which changes the morbid growth into an abscess, and which either can be opened or allowed to discharge itself spontaneously, and so the tumor is got rid of.

But there are still a number of cases in which such a procedure is inadmissible. In such cases we may introduce small insulated needles into several parts of the growth, using a current just strong enough to cause small eschars or coagula to form around the needles,

which interfere with the nutrition of the growth by acting as barriers to the blood-supply, and which are not sufficiently large to cause suppuration, but after a time are absorbed; besides this, the action of the current exercises its catalytic effects, and assists in promoting absorption of the tumor.

The operation first described is seldom required, except in the case of recurrent fibroids. Of the two last-mentioned operations the following cases serve as illustrations both of the method of operating and of the results to be generally expected.

CASE LIX.—*Submucous Fibroid of Uterus.* Mrs. G., æt. 40, a lean, spare woman, sent for me on May 28th, 1873, on account of a profuse uterine hæmorrhage, from which she suffers at intervals varying from five days to two weeks. I found her quite anæmic and prostrated, but the flow almost entirely ceased; prescribed China[12], promising to make a uterine examination next day.

May 29th.—Hæmorrhage ceased. Found a large submucous fibroid, about the size of an infant's head, occupying the upper and anterior part of the uterus, causing that organ to be anteflexed. I informed the patient of the existence of the tumor, and suggested treatment by electrolysis, which was at once consented to.

May 30th.—With the assistance of my friend Dr. Pennoyer, of Brooklyn, I divided the cervix as far as the os internum, and then introduced a large sponge tent to effect still further dilatation.

May 31st.—Removed sponge tent, and finding the os sufficiently dilated, proceeded to operate. Passing a long, thick platina needle, insulated to within an inch of the point, along my finger into the uterus, I plunged the needle into the tumor, for about an inch and a half (the patient being kept under the influence of nitrous oxide), and connected it (the needle) with the negative pole of a zinc and carbon battery, using thirty cells, and completing the circuit by means of a sponge rheophore placed over the abdomen externally. I allowed this strong current to pass for ten minutes, and then reduced the number of cells to eighteen, which I continued to use for ten minutes more, when I withdrew the needle.

June 1st.—Considerable abdominal tenderness and ovaritis; pulse 120. Ordered Aconite every two hours.

June 2d.—Less tenderness; pulse 80. Stopped Aconite.

June 3d.—No fever or tenderness; large offensive slough passed from vagina, with considerable fetid discharge and some slight hæmorrhage. Evening of June 3d, I introduced a fresh sponge tent, to be left in until the following morning.

June 4th.—Removed tent. Tumor smaller. The vagina being large and lax, I had no difficulty in introducing my hand into it and my finger into the uterus. The tumor had become quite soft and had a large hole in the centre about an inch in diameter, corresponding to the spot where I had introduced the needle. After this date I transmitted daily a current from sixteen cells through the uterus, one electrode (metallic) on the os uteri, and the other (sponge) on the abdomen externally. Tumor steadily decreased in size up to June 30th, when I discontinued treatment.

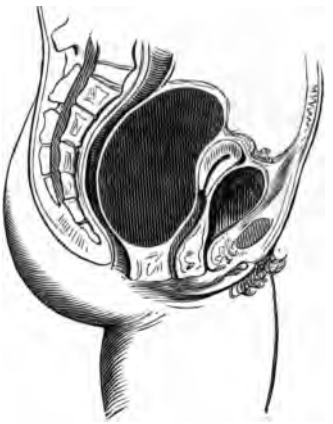
October 3d, 1873, examined patient and could not find a trace of the tumor; menses normal. Says she has increased ten pounds in weight.

She is now, October 3d, 1877, in perfect health.

CASE LX.—*Subperitoneal Fibroid of Uterus.*—On September 30th, 1875, I was sent for by my friend Dr. South, of Plainfield, N. J., to see a patient of his, who was suffering from a uterine fibroid tumor. The patient, a woman of about forty years of age, never had children, was extremely pale and debilitated, suffered from œdema of the lower limbs and from some general anasarca, difficulty and excruciating pain in urinating, the pain from which lasted almost until the next urination, gradually subsiding, only to be again produced at each urinary passage. No attempt could be made to evacuate the bowels without the use of an enema. The woman suffered continual pain in bowels. Nights were entirely sleepless; appetite bad; pulse 94; temperature 100. On making a physical examination, I found that the uterus was almost out of reach of the finger; but after some difficulty I found the os, and managed to introduce a sound into the cavity of the uterus. I found it was much smaller than normal, as was also the bladder, both of which were drawn upward and forward from their usual position, thus lengthening the vagina and urethra to a considerable extent. I then found that the greater part of the pelvis was filled by a hard fibrous tumor, which was attached to the posterior wall of

the uterus and ascended above the fundus, descending between the vagina and rectum, upon which latter it exercised a great amount of pressure. An examination per rectum gave a fair idea of the size, weight, shape, and position of the growth, which is fairly delineated in the drawing, Fig. 29.

FIG. 29.

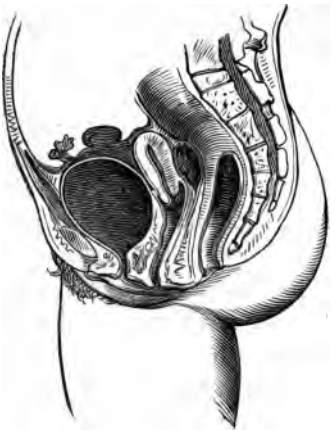


After examining the patient thoroughly, I was informed by Dr. South that a distinguished old-school surgeon from this city, and a well-known gynæcologist of our school from Philadelphia, had seen the patient about a week or ten days previously, and that both were of opinion that nothing could be done for her except to mitigate her sufferings by prescribing for symptoms as they arose, or keeping her under the influence of anodynes as long as she lived. Now, as the patient's friends and family physician were unwilling to let her die without attempting something for her relief, I suggested electrolysis, explaining thoroughly the details of the operation, the risk of peritonitis, and the chances of the success of the operation, which I need not say were not at all encouraging. However, I appointed the 9th of the following month (October, 1875) to operate.

October 9th:—The patient being chloroformed by Dr. South, I dilated the sphincter ani and succeeded in getting my left hand into the rectum as far as possible above the lower part of the tumor. I then introduced two needles, insulated about half their length and

connected with the positive pole of the battery, through the rectum into the posterior part of the tumor to a little above the centre. Having placed the needles *in situ* I withdrew my hand from the

FIG. 30.



rectum and introduced two similar needles through the vagina into the tumor; these I connected with the negative pole of the battery, and having allowed a strong galvanic current to flow uninterruptedly for about five minutes, I partially withdrew the negative needles and inserted them in another direction, and again changed the position of the negative needles *only*, every five minutes for about half an hour, which was the length of time consumed in the operation. The patient was kept strictly in the recumbent position, given Aconite and Arnica.

October 15th.—Pulse 100; temperature 102; not much appetite. Tenderness of abdomen less than before operation. Difficulty of urination decidedly less, and urination less frequent. Ordered external faradization. I did not see the patient again until October 22d, when I found a very decided change. The temperature and pulse were normal; the tumor considerably reduced in size; micturition less frequent; bowels act naturally; gave patient permission to get out of bed. I did not again see her until the following January, when I made a very thorough examination, and found that the tumor could scarcely be reached with the finger in the rectum, and could

not at all be felt in the abdominal walls. She had *no pain;* all functions normally performed, and she had resumed her household duties, had gained considerable flesh, and expressed herself as feeling quite well, and has continued so ever since, I am informed by Dr. South. Fig. 30 is a tolerably good representation of the condition of the growth at my last visit, and I have no doubt that since then it has undergone still further reduction, if not entirely disappeared.

CASE LXI.—*Fibrous Goitre.*—Miss ——, æt. 18, consulted me September, 1873, relative to a large fibrous goitre, involving both lobes and body of the thyroid gland. It was much larger on the right side than on the left. I unfortunately did not measure the circumference of the neck. The growth not appearing to be quite as hard as the average, and having a little doubt of the correctness of my own diagnosis, I had Dr. E. J. Whitney see the case, who confirmed my diagnosis as to the fibrous character of the tumor. I made up my mind to destroy the growth by electrolyzing sufficient of each division of it (one part at a time) to produce a small abscess in each part, and get rid of it by suppuration. My first operation was performed with a view of destroying the right side of the growth only. To this end (the patient being placed under the influence of an anæsthetic by my friend Dr. Pitts) I introduced two large insulated needles (platina) into the right lobe, to about three-fourths of its depth, about one inch of the tips of the needles being uninsulated. I closed the circuit by connecting these needles with the poles of the battery in the usual manner.

I must here omit an amount of detail that is unessential and uninteresting. Suffice it to say that an abscess formed, which was opened two weeks afterwards. This removed the whole of the right side of the goitre. After a few weeks I performed a similar operation on the left side, with a like result; and in two months afterwards a third on the central portion successfully. I saw this patient a few weeks ago, and with the exception of the slight scars left where the needles were inserted, there is nothing to indicate that there had been any goitre.

I have now a case of fibrous goitre under treatment, which is gradually diminishing, by merely creating very small coagula in different parts of the growth, so as to mechanically impede the blood-supply,

taking care at the same time not to produce an eschar large enough to excite suppuration. In this operation we, of course, also utilize the dynamic action of the current in favoring absorption, and one great advantage the procedure has over all others is, that except as regards the insertion of the needles it is quite painless when properly performed.

I have treated a great many large subperitoneal uterine fibroids in this manner; some with a view only of arresting their growth, some with the intention of going a step farther and diminishing their size, and others (as case illustrated by last cut) with the object of getting eventually rid of them, and in no one case have I yet been disappointed in the result obtained.

CHAPTER XXIV.

ADENOID TUMORS.

THESE morbid growths, besides being amenable to the treatments already described as applicable to fibrous tumors, can be dispersed when not very large by the absorbent or catalytic action of the current. The following cases serve to illustrate these facts:

ADENOID GOITRE.

CASE LXII.—Miss E. D., aged 21, was sent to me, on June 21st, 1877, by my friend, Dr. South, of Plainfield, New Jersey. She complained of a large growth just below the larynx in the centre part of the neck, which interfered with her voice and impeded respiration. This tumor had been growing some four years, and latterly had rapidly increased. I diagnosed the case as one of adenoid goitre, and gave a favorable prognosis. I then operated by inserting two insulated platinum needles, active at their points for about an inch, obliquely into the growth and about an inch apart. These were connected with six cells of a Daniell's battery. The application was continued for about fifteen minutes. This operation

was repeated on the 23d, from which time I did not again see her until July 7th, when I found the growth, though very much inflamed, considerably reduced in size and discharging pus slightly from the opening made by the negative needle. Her temperature was 101½, and pulse 96. A very small portion of the growth seemed not to have been acted upon at all by the current, so I made another mild application. On the 16th had another interview with the patient. The whole growth seems to have disappeared; dismissed to report in September. September 20th, a very slight enlargement of the gland remaining, I introduced two very small needles and transmitted a mild current for about five minutes. This effectually removed all the morbid tissue, and now she has not a vestige of the original trouble remaining. Any pain that the insertion of the needles might have produced was entirely avoided by a local anæsthetic. There is no scar nor any evidence to show that any morbid growth had ever existed.

CASE LXIII.—M. T., a boy, æt. 11, was sent to my office from Rockland County on account of a tumor in the neck, which at first sight looked like a fatty tumor, but on a minute examination was found to be adenoid, and attached to the ala of the thyroid. It was divided into three distinct lobes (as seen in the photograph, Fig. 31), the middle one of which was the largest. It had no connection whatever with the parotid, was not painful or even tender to the touch, and only inconvenienced the patient by interfering slightly with the movements of the neck and head. The measurement around the neck was 15½ inches.

November 13th, 1875. With the assistance of Drs. Minton and Radcliffe I punctured the growth with two insulated needles, operating on each lobe separately. I made applications externally to the growth every day up to the 18th; measurement 13¾ inches. Operated again on the 21st and 27th of the same month. December 5th, measurement 13 inches.

The parents were satisfied with the amount of reduction produced, and as it was very inconvenient boarding the boy in the city, took him from under my care. I saw the boy's father about three months afterward, who told me the tumor had almost disappeared, and was scarcely noticeable.

The boy, I understand, has since died of an attack of acute dysıtery, caused by a severe cold contracted by being exposed to a rainorm in an open boat. The minute particulars of his illness I have ɔt been able to ascertain.

I would add, however, that several months had elapsed between e disappearance of the tumor and the attack of dysentery, and of

FIG. 31.

urse it is unreasonable to suppose that the former could be in any ay connected with the latter.

Fig. 32 is taken from a sketch made from measurement, and hile, perhaps, not absolutely correct as a photograph would be,

fairly delineates the boy's condition at the time he discontinued treatment.

FIG. 32.

ADENOID TUMOR OF BREAST.

CASE LXIV.—C. F., an unmarried lady, æt. 22, called on me on June 14th, 1877, on account of a small growth in the lower part of her right breast. Said she noticed it as a very small lump about four years ago, since which time it had slowly increased, and latterly it was occasionally very painful. I made an application of a very mild galvanic current by means of two fine platinum needles, every

five or six days, with a view of promoting absorption. The result was that after five such treatments the growth disappeared.

FATTY TUMORS.

Fatty tumors are bad electrolytes. Fat being a very poor conductor, a current of extreme intensity is necessary to produce an appreciable effect.

The amount of inflammation caused in the surrounding structures by a current of such tension renders this operation objectionable, and in treating these tumors I never resort to it, except the patient has an insuperable aversion to the knife.*

CASE LXV.—Mrs. M. S., æt. 50. Fatty tumor above clavicle. Operated February 27th, 1874. Two large needles were driven into the growth through its whole diameter, parallel to each other. A current from thirty-two Stöhrer's elements was passed for half an hour uninterruptedly.

February 28th. Considerable inflammation of the tissues adjacent to the tumor, the glands in the vicinity participating.

Patient could not move the head. These symptoms all subsided in a few days, leaving the tumor in much the same condition as when I saw it first, with the exception of a small eschar which had formed in the track of the needles. This slough separated a few days after, leaving the rest of the tumor as before. I operated again three times before the whole of the abnormal structure was destroyed. The slough separated and discharged itself through an aperture, large enough to admit three fingers, made by the cauterizing effect of the uninsulated needles upon the skin, about ten days after the last operation. This effectually removed the whole growth.

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* In any case where excision might be inadmissible, enucleation by the electro-chemical treatment previously described, performed with zinc needles, is quite practicable, and comparatively, if not entirely, painless.

CHAPTER XXV.

CYSTIC TUMORS.

In the treatment of these tumors by electricity, the character of the contents, as well as the size and location of the growth, must furnish the guides as to which stage of electro-puncture we are to use. As a general rule, I may state that the fourth stage, or complete electrolysis, is seldom indicated. When the contents of a cyst are semisolid we may produce by electro-puncture an internal eschar, which causes the cyst to suppurate (this treatment is not suitable for very large cysts), or by repeated mild operations we may not only destroy the secreting power of the cyst, but also, owing to the catalytic effect of the current, cause absorption of the contents. In cysts with serous contents, the object of electro-puncture is *to promote absorption of the fluid, and destroy the secreting power of the cyst.* Coagulation of the albuminous parts of the contents must be as far as possible avoided, and it is almost unnecessary to add that the current should never be used of such a strength as to run the risk of having suppuration follow. As to the capacity of the current to destroy the secreting power of the sac, I have no theory to offer. It may be due to the action of the very small quantity of acids or alkalies that form at the points of the needles (as some say), or it may not; however, we know it to be a fact that it has this capacity, and our knowledge on this point ends here. I propose to give the history of the treatment of a case or two of each of the forms of cyst mentioned, that is, of those with semisolid contents and those with serous.

Case LXVI.—I. N. S., æt. 41. Cystic tumor on lower lip, about the size of a small walnut, operated upon with a view of causing suppuration, by means of two insulated needles, one from each pole of battery; current from twelve Smee elements. Abscess formed; contents evacuated ten days after operation, cavity healed and filled by granulation. No disfiguring scar left.

CASE LXVII.—December 9th, 1873, Miss C., a maiden lady, æt. 40, called at my office relative to a "lump" in the left breast. I found a tumor about the size of an egg; nipple *retracted*. Patient said the tumor was quite painless. Her general health seemed good. The breast being quite pendulous, I had no difficulty in making a rough estimate of the specific gravity of the growth, which did not seem to be greater than the surrounding healthy tissue. I pronounced the disease a fibro-cystic tumor, which seemed to surprise the patient, who then informed me that two very prominent allopathic physicians (mentioning their names) had told her it was cancer. She, however, accepted my diagnosis, and appointed next day for operation.

December 10th. I inserted four insulated needles, connected with the negative pole of battery, into the tumor, completing the circuit with a moistened sponge rheophore placed on the breast. After having allowed the current from a Stöhrer's battery to flow for about twenty minutes, I withdrew the needles. There was considerable enlargement of the breast, which crepitated on pressure, owing to the pent-up hydrogen evolved by the current bubbling through the tissues. Firmer pressure expelled a little of the contents of the cyst through the opening made by the needles, which sustained my diagnosis as to the cystic nature of the growth.

December 11th. Breast inflamed and very painful. Thin fluid dribbled from openings made by needles all last night. No internal treatment. Cold-water dressing.

December 16th. Inflammation subsided; needle-holes all healed but one, from which a purulent discharge exuded. Tumor reduced to about one-third its original size; no pain. Patient resumed her ordinary avocation (dressmaker).

December 20th. Growth further diminished. Discharge of pus still continues.

January 4th. Needle opening healed. Tumor gone.

CASE LXVIII.—Mrs. R., æt. 30. Cystic tumor of anterior lip of cervix uteri. Operated upon in May, 1873. The current was allowed to act through two needles until complete coagulation of the semiliquid contents of the tumor took place. Very trifling

inflammatory symptoms after operation. Suppuration of cyst occurred, abscess discharged, and cavity healed.

A form of fluid cyst which gives brilliant results from electropuncture is hydrocele. The most usual mode of operating is to introduce an insulated needle connected with the negative pole of the battery into the cyst, and complete the circuit with a sponge rheophore placed in the groin. I much prefer, however, to use a needle from each pole, and insert both into the cyst. Only a mild current is necessary. The applications have in some cases to be repeated three or four times, in others once is sufficient.

The subjoined case, which was operated on by a Dr. Campbell, and reported by Althaus,* so far exceeds in magnitude any of the cases which I have myself treated that I copy it in full, to show what *can* be done in such cases by electricity:

CASE LXIX—"R. M., æt. 42 years, came under treatment on November 20th, 1870. He had been troubled with chronic orchitis and hydrocele on the left side for upwards of fourteen years; the former was the result of a blow, and had gone on until the testicle was now about three times its original size. The latter had been frequently emptied by tapping, and usually filled again in a few weeks. On examination the left side of the scrotum was found to offer the usual appearances of hydrocele; the testicle was pressed up against the left abdominal ring, and could easily be felt in that position. At a rough guess the sac might be estimated to contain about thirty ounces of serum. Before proceeding to electrolysis, I felt disposed to draw off some of the fluid, but on second thought concluded it would be better to allow it to remain, so as more fully to test the power of the electric current, and also, by distension of the sac with its full amount of liquid, allow the whole of the secreting surfaces of the sac to be exposed to the same action. I accordingly introduced three gilt steel needles, each two inches long, into the sac, and connected them by means of Dr. Althaus's serres fines conductor with the negative pole of a Foveaux's battery. The circuit was completed by placing the positive electrode in the groin of the same side. A power of ten cells† was first used, as the patient was nervous and intolerant of pain; but this was gradually increased to twenty cells, as he

* Op. cit., p. 672.

† Equal to five volts.

became convinced it did not hurt him. The current was allowed to pass for fifteen minutes, during which time, by aid of the stethoscope, a well-marked crackling could he heard in the hydrocele, evidently marking the evolution of hydrogen, and proving that the electrolytic action of the current was going on freely. On withdrawing the needles no bleeding occurred, and beyond a slight puffiness no change was perceptible externally. He was seen again on the 23d. By that time the swelling was entirely gone, the sac was quite empty, no inflammation had come on, and the œdema which always follows acupuncture in the usual manner, had been entirely wanting. In fact no unpleasantness of any kind had followed the operation. He was seen occasionally after this, but nothing worthy of note occurred, except that he could observe the left testicle was gradually lessening in size. On February 5th following, after a most careful examination, no trace of the hydrocele could be discovered. The left testicle was reduced to its normal size, and the scrotum was of the usual healthy appearance. More than a year having now elapsed without the least symptom of return, we may reasonably assume that the cure is radical. One very important conclusion may be drawn from this case, viz.: That electrolysis not only decomposes the contents of a serous sac, but produces such a profound alteration of the nutrition of its secreting surfaces that no further serum is poured out. I had not anticipated any alteration in the enlarged testicle, but the absorption of the products of inflammation in its parenchyma is another noteworthy circumstance, more especially as chronic orchitis usually leads to degeneration of the substance of the gland itself. I have seen this patient as recently as December 21st, 1871, and after a most careful examination, can discover no trace of the disease."

The strength of current used in this case is more than the average hydrocele will tolerate without mischief being done; but in this case the size of the sac offered considerable resistance to the passage of the current, and when we take into consideration that the circuit was completed by the positive sponge being placed on the skin externally, it is fair to estimate that the actual amount of current acting upon the fluid was by this resistance diminished to at least one-fourth what it would have been had both poles been made to act within the sac.

OVARIAN CYSTS.

The treatment of ovarian cysts by electro-puncture is yet in its infancy, but promises, I think, eventually to supersede ovariotomy in suitable cases. When properly performed there is but little risk to the patient. The openings made by the needles are much smaller than that made by the trochar in the operation of tapping. When the needles are properly insulated, as they are by Kidder's patent process, there is no possibility of the current acting on the peritoneum. No pain attends the operation, and when performed with due care and skill, there is no danger of suppuration of the cyst ensuing, and certainly much to hope for in the way of a cure. Of course unilocular tumors give the greatest promise of success, and are most easily operated upon. I must here say that, after having read all the available literature on the subject, I could not help noticing that in all the cases where this operation was followed by disastrous consequences, it was performed by persons who understood but little of electro-physics, as the reports of the cases abundantly prove. In one case, the autopsy of which I attended, needles had been actually used, at which there was no attempt at insulation whatever, and more than this, the operator had actually missed his mark in making the puncture; and instead of perforating the tumor, one of the needles had punctured outside of it, and the surgeon had been positively acting upon the peritoneum with the galvanic current *secundum artem*. This case was reported in one of our leading journals as "Electrolysis of an ovarian tumor followed by death."

The case needs no comment.

We will pass from this side of the question and study what the operation properly performed promises as a means of cure.

Dr. Fieber, of Vienna, has reported six cures following electro-puncture. One of his cases, reported by Althaus, I here copy.

CASE LXX.—"The patient, a needlewoman, æt. 31, had a fall in November, 1866. She suffered from various symptoms afterwards, and first noticed a tumor, about the size of a fist, in January, 1867. When she came under treatment, in June, 1870, the tumor was the size of the head of an adult. It was not tender, but hard and nodulated, and occupied a space commencing half an inch above the umbilicus

and ending about one inch above the os pubis; its width amounted to six inches.

"The first electrolytic operation was made early in June, and it was repeated eleven times.

"At first, the tumor decreased only slowly, but at last rapidly. In March, 1871, it had been reduced to the size of a fowl's egg, and gave no inconvenience."

Dr. Murphy, of New Orleans, Dr. Hesse, of Brooklyn, Dr. Hayes, of Chicago, and a number of other surgeons have also reported successes.

I believe that to Dr. Emil Flies, of this city, is due the honor of being the first to perform this operation, at least he was the first to call the attention of the profession to the subject, in a paper read before the Berliner Medicinische Gesellschaft in 1869, which paper can be found in the *Berliner Klinische Wochenschrift*, March 8th, 1870.

The most satisfactory mode of operating seems to be the introduction of needles from both poles of the battery, and the use of very mild currents frequently repeated. Of course, as may be inferred, the intensity of the current as well as the length of each application will depend in a great measure on the size of the tumor. But in all cases we must remember that we only aim at absorption of the fluid, and the electrical effect in abolishing the secreting power of the sac, and *not* at electrolysis or the creating of an abscess.

HYDATID CYSTS OF THE LIVER.

These abnormal growths may be treated in a manner similar to cysts with fluid contents in other parts, with the same object in view and with a similar result.

Drs. Durham and Forster report eight cases successfully treated in *Medico-Chirurgical Transactions* for 1871, page 1, *et seq.* One of these cases is reported by Althaus, in his work already quoted, page 692.

POLYPUS.

Polypi of the nose or elsewhere are readily amenable to electrolysis. Most authors insert needles into the growths and destroy them as they would other tumors. This, however, is a tedious process,

and the following substitute is much more easy of application. I use a fine silver wire loop, inserted through a stiff catheter made of rubber or some equally good non-conductor; slip this loop around the pedicle of the polypus, attach the wire to the negative pole of a battery generating a current of about twenty-five volts, and complete the circuit either with a needle from the positive pole inserted into the substance of the tumor (which, if possible, is the preferable way), or with a sponge rheophore placed on the most convenient adjacent part. The electrolytic effect of the current soon not only cuts the pedicle through, but also cauterizes the spot from whence it took its attachment.

I believe that cases operated upon in this manner show less liability to return than those removed by any other method. The cases which follow illustrate the method of operating.

CASE LXXI.—L. O., æt. 28, was sent to me on February 10th, 1877, by my friend, Dr. Lewis Hallock, of this city. On examination I found a number of small mucous polypi in the nares (both sides). I electrolyzed several of them separately in the manner described; but, on account of the day being far advanced, and darkness coming on, I was obliged to postpone further operative measures.

February 13th. Removed two more polypi by the same means, and besides, cauterized the spot from which the pedicles took their attachment with the negative pole of the battery. But two small growths now remained; these, after repeated trials to pass the loop around them, and failing to do so, I removed by torsion with the polypus forceps, cauterizing the spot from whence they grew by the action of the current. For a year I heard nothing of the patient, but on the 11th of February of that year he made his appearance at my office, saying that he thought the polypi were coming back. I examined the nares, and on the septum of the nose, in the anterior nares, grew two little polypi. The rest of the membrane seemed healthy. I removed these as in the first instance.

CASE LXXII.—A. M., æt. 54, was sent to me by my friend, Dr. Peterson, to have a polypus of the right side of the posterior nares removed.

The growth occupied almost the whole cavity of the nose; it could

be readily seen either through the nostril anteriorly, or with the pharyngeal mirror through the pharynx posteriorly. After a little difficulty I succeeded in passing the loop around the pedicle, which was a thick one; and then attaching the battery, I cauterized it through in about five or six minutes. The next thing was to get it out. The growth was really so large that I hesitated whether to try and deliver it through the nostril, or push it back into the pharynx. I, however, finally succeeded in bringing it through the nostril. No return.

CHAPTER XXVI.

MALIGNANT TUMORS.

FROM time to time there has been considerable discussion as to whether the removal of a malignant growth by electrolysis afforded a patient a greater security against its reappearance than simple exsection by the knife.

Both sides of the question have had warm supporters, and during the past few years the medical journals, both of this country and Europe, have discussed the matter freely.

I believe now it is fully conceded that electrolysis affords considerable protection against a recurrence of any kind of malignant tumor.

If malignant tumors be the result of a mistaken nerve impulse, causing the secretion of morbid or mistaken cells, is it not reasonable to suppose that any agent having the power to alter the morbid condition of such nerve or nerve-centre (whether that alteration is effected through the law of similars, or antipathically, or otherwise), and at the same time can destroy and effectually get rid of the heterologous tissue, that such a remedy is superior to all others?

We have shown in the first part of this work that there is no agent that has such a powerful effect on nerve functions as electricity (see pages 16 and 25). Now whether the current will act in such a way as to restore the healthy function of the nutrient or trophic nerves of a part affected with cancer, after having destroyed the dis-

eased part, can only be decided by experience. I have operated on a great many cases of malignant growths by electrolysis,* and so far have had only two reappear; and I would add that most of the cases sent to me for treatment were those that eminent surgeons refused to operate upon by the knife.

As it is manifestly unfair to report any case of malignant disease cured by any method unless at least a year has elapsed from the time of the treatment without any appearance of recurrence, cases of two, three, and four years' standing are only here recorded, excluding all those which have been more recently treated.

CASE LXXIII.—C. N., æt. 60, a feeble, cachectic-looking man, sent for me July 31st, 1874. I found a large open scirrhus situated immediately below and to the right of the inferior angle of left scapula. The growth has existed, as far as the patient remembered, about two years. Had been ulcerated about a month, from which time he suffered considerable pain. The odor was characteristic. I operated by introducing several steel needles connected with the negative pole of a Stöhrer's battery into and beneath the base of the growth, forming the circuit by a large platinum needle from the positive inserted into the body of the tumor, destroying the whole of the morbid tissue in one operation. The entire scirrhus sloughed away on the sixth day, leaving an ulcer about three inches in diameter. Not being satisfied with the appearance of this ulcer, which was indolent-looking, with hardened edges, and secreting a sanious discharge, I performed a second operation, about eight days after the first, destroying the tissue around the ulcer for about a quarter of an inch, and for about a quarter of an inch in depth. The tissue electrolyzed separated about the fifth day, leaving a large healthy wound, which healed rapidly under the use of a weak Calendula lotion. This patient's health steadily improved. Three months after the first operation he had gained ten pounds in weight. No new growth since.

CASE LXXIV.—W. L., æt. 54. Epithelioma at external canthus of right eye, about the size of a walnut. Operated by introducing

* This operation must not be confounded with galvanic cautery, which, of course, affords no protection against a recurrence.

two needles carrying a very weak current (twelve Smee cells) into the base of the growth. The patient would not submit to the use of an anæsthetic, so I was obliged to suspend the operation for four or five minutes several times during the seance to give him a respite from the pain, as it became intolerable. There was a very little congestion of the eye on the day following the operation. The ulcer had entirely healed on the tenth day after the slough had separated.

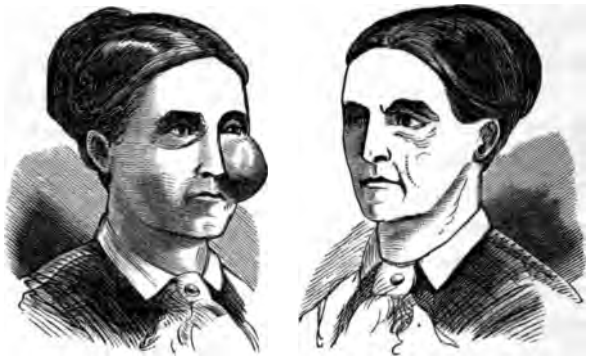
CASE LXXV.—On September 13th, 1874, Mrs. M., æt. 50, consulted me in reference to a large tumor on the left side of the face, extending from the margin of the lower eyelid to about half an inch below the angle of the mouth, and from the third middle of the malar bone to the bridge of the nose. In shape and appearance it resembled a female mamma, which resemblance was further increased by a nipple-shaped protuberance in the centre, from which, at the time of her visit, there was some slight hæmorrhage. There was no difficulty in diagnosing the case as being medullary sarcoma. The patient gave me the following history: About a year ago she found a small lump was growing on the side of her face, close to the nose, for which she consulted a Brooklyn surgeon, who told her accurately the nature of her disease, and recommended removal; but at that time, as she had not her mind made up to the sticking-point, she declined any operation. However, in eight months afterwards, she changed her mind and was operated upon by the same surgeon, who removed a large portion of the superior maxilla of that side, part of the palate and soft palate. Almost upon the healing of the wound the tumor appeared again, and in four months after the operation (when I saw her) it was larger than ever. She went to the surgeon again, who declined any further operative measures. Aside from the condition described, the patient was in very tolerable health. Appetite good, pulse and temperature slightly above normal. She was very anxious to try electrolysis, and as she realized fully her condition, and, as she expressed it, was as willing to die under treatment as without it, I consented to operate.

Fig. 33 *a* is copied from a photograph taken on the day of her first visit to me, September 13th, 1874.

September 14th. The patient being under the influence of ether, I introduced five uninsulated needles into the base of the growth.

These I connected with the negative pole of a galvanic battery, the circuit being completed by three similar needles conveying the current from the positive pole and inserted into the tumor at its junction with the nose. The position of the negative needles was changed every two or three minutes, as the tissue in contact with

FIG. 33.



a. *b.*

them became sufficiently acted upon, and the operation concluded in half an hour. Cold-water dressing applied locally.

September 15th. Pulse 120. Vomited twice during the night. Chemosis of the left eye, the sight of which was almost obscured. Punctured conjunctiva and relieved chemosis. Ordered Aconite every hour.

September 16th. Inflammation of eye much better; can see a little. Tumor black and offensive. Ordered lotion of carbolic acid and glycerin.

September 17th. Whole growth sloughed away, except the part on lower eyelid. The ulcer beneath the slough seemed healthy and secreted laudable pus.

September 18th. Sight completely recovered. Appetite good. Pulse normal. Slept well last night.

The patient progressed well for two or three weeks after this, with the exception, of course, of the part of the growth left on the lower eyelid, which had not been operated upon, when the ulcer became

* From a photograph taken 1876.

fungous-looking, a new growth appearing at the superior and external part of the ulcer. With the assistance of Dr. Varona I removed the growth on the eyelid by means of galvano-cautery, and the new growth by electrolysis. I will explain here that I used the galvano-cautery on the remains of the old tumor, not because I considered it a preferable mode of procedure, but simply because I was afraid that the intensity of the current requisite to destroy the morbid tissue by electrolysis might produce serious inflammation of the eye. After this the patient did well, the wound healing promptly, but leaving considerable ectropion and deformity of the face. The ectropion I operated upon about a year afterwards, with what success is better shown in Fig. 33 *b* than I can express in writing.

Perhaps I should say here that besides the operative measures mild galvanic currents were passed through the site of the growth and surrounding parts several times during the healing of the wound.

CASE LXXVI.—In July, 1376, I was sent for by my friend, Dr. Helmuth, to see Mrs. G., æt. 54. She had a large epithelial growth, which covered the right malar bone, and extended from within about an inch of the anterior part of the ear to about the middle third of the eyebrow. In this direction the tumor measured about two inches and a quarter, its vertical measurement being probably two inches. It stood out from the face to the extent of about half an inch or less at the extreme edges, and was considerably more raised in the centre. The patient said the disease grew from a mole, which was often irritated by the accidental rubbing of a comb. She could not give any clue to the date at which the mole became transformed, but said that the disease had troubled her some two years, and had slowly assumed its present size. After a consultation we decided to remove the disease by electrolysis. We operated upon the growth while she was under the influence of ether by the method used in the case last described, completely electrolyzing the whole of the morbid tissue, and as much of the contiguous healthy flesh as was in our estimation thought necessary. The slough came entirely away in about ten days, the wound resulting healing by granulation, and I learn from Dr. Helmuth that the lady has had no return since, and remains well in every respect.

CASE LXXVII.—Mrs. A. C. F., aged 40, was sent to me by Dr. Fowler Ormsbee, of Orange, N. J., on November 25th, 1876, on account of a lump which she complained of in her left breast. It had existed for about six months, was hard and inelastic to the touch, and about the size of the English walnut. The nipple was retracted, and the patient complained of intermitting sharp shooting pains through it. It presenting all the characteristic symptoms of scirrhus, I diagnosed the case accordingly, and suggested treatment by electrolysis. I should here say that the glands in the axilla were not at all involved.

The patient being placed under the influence of ether by Dr. Ormsbee, I introduced two large insulated needles into the base of the growth, connected with these a Stöhrer's battery, and allowed a current of twenty cells to flow for about five minutes. I then withdrew the negative needle and introduced it into another place, and removed it to a new place about every five minutes until the whole growth was undermined by the action of the current, which result was accomplished in about half an hour. The patient reacted from the anæsthetic well. Ordered flaxseed poultice to be applied until the slough separated. On the 26th a grayish-black eschar covered the site of the growth; very little pain was complained of; ordered flaxseed poultice to be continued. On December 4th the slough separated, leaving a healthy granulating surface; almost the whole of the entire growth destroyed. On December 13th, noticing what I supposed to be a small portion of the scirrhus remaining, I again passed a mild current through it in a manner similar to that already described. The slough of this soon separated, and the wound had entirely healed by January 16th. After this the patient had no trouble, and has not had up to last October, which was the last time I heard from her.

In destroying malignant growths by electrolysis the same rule should be observed as when operating by the knife, that is, to be sure to remove all the diseased and doubtful tissue, and as much of the surrounding healthy flesh as is prudently admissible. Indeed, in these diseases the contrary of the general rule before given is to be observed, viz., it is better to destroy too much than too little. There are advantages that this operation has over the knife besides those already mentioned, and they briefly summed up are:

1st. We disable the surrounding absorbents, and constrict or destroy the bloodvessels in the vicinity, so that there is little danger of the regrafting of any of the heterologous tissue that may accidentally escape total destruction; 2d. No hæmorrhage, or but little; 3d. No shock; 4th. No liability to pyæmia; 5th. After the separation of the eschar there is an exposed granulating surface always under the eye of the watchful surgeon, who can step in and interfere at any time during the process of healing, if he is not entirely satisfied that every cancer-cell has been removed in the first instance.

There is a class of cases which must be considered incurable, either because the entire system has become impregnated, or else the whole of the local disease cannot with safety be removed. In such cases much can be done towards prolonging the patient's life by galvanism.

Pain can in all cases be relieved, either by electro-puncture or by a galvanic current, applied externally to the growth and surrounding parts, even when anodynes and narcotics fail to relieve. Indeed, it is no uncommon occurrence for a patient in the last stages of cancer, who has been racked with agony, passing whole days and nights in sleeplessness, to fall asleep during the first application of the galvanic current, while the needles are actually sticking in the diseased part. The case which follows is a fair example of what can be done in ameliorating the disease, improving the patient's condition, and prolonging life, where there was no possible hope for a cure taking place:

CASE LXXVIII.—Mrs. C., æt. 50 (while I was attending one of her family), casually complained of a tickling cough, with synchronous spirting of urine. I prescribed Caust.[30], which she took for two days without benefit. She was then put on the 200th of the same remedy, a dose every night for a week. No better. Afterwards used several remedies that I thought indicated, without the patient's experiencing any beneficial effect, or any effect, in fact. On examining the chest, I found dulness on percussion over the entire superior lobe of right lung. No respiratory murmur present in this region. Puerile respiration in left lung, unequal expansion of chest in inspiration, visible pulsation of carotids. Pulse 120, temperature 101. As this condition did not explain the bladder symptoms, I insisted on an examination of that organ, but found no lesion there.

However, as the patient lay on the couch, she was attacked with a severe fit of coughing, which caused a profuse thin fetid discharge, slightly tinged with blood, to spirt from the vagina. Upon making a digital examination, I found the whole vaginal canal filled with a large cauliflower excrescence.

The hæmorrhage caused by touching it was so severe that I was obliged to postpone further exploration, and ordered a lotion of persulphate of iron and water to be applied by means of a cotton tampon, with a view not only of controlling the hæmorrhage, but also of hardening the growth, which was so soft and brittle as to break down under the slightest pressure.

A few days afterwards I was able to make a thorough examination without the least inconvenience. I found the whole cervix involved, the glands in the groin enlarged and hardened. Vagina entirely filled with the morbid tissue. Gave an unfavorable prognosis. I ordered Lapis albus[3], and suggested having vaginal growth removed by electrolysis, with a view to prolong the patient's life as long as possible. I operated on July 1st, by means of long-curved needles with cutting edges. Used a current of medium intensity (twenty Stöhrer's elements); destroyed the whole cervix as far as the junction with vagina. The large mass sloughed away two days after, leaving only a small portion of the diseased tissue remaining; on this I operated again, destroying it almost completely. The patient, on my recommendation, went to the country for four weeks; in that time she gained five pounds in weight, and on her return looked much improved. The discharge had entirely ceased, cough not so troublesome; the pulse and temperature, however, remained the same, and the inguinal glands were much larger, and had begun to be painful. I advised her to go to the country again, and continue the Lapis alb. I saw this patient again in four weeks; she was then in about the same condition as when I first saw her first, with the exception that a large scirrhus had formed in the left groin, and the growth in uterus returned. I consulted with Dr. Varona as to the advisability of further operating. We came to the conclusion that no operation was likely to prolong the patient's life, so I abandoned the idea. In a month after this the tongue became involved, also the cervical glands, soft palate, and pharynx; the scirrhus in the

groin ulcerated. The patient rapidly became emaciated, and died six months after the first operation.

The electro-chemical treatment of malignant tumors, which I spoke of at page 173, is a matter of too recent date to give a positive opinion upon. However, so far as I have used it, I am well pleased with the results, and hope at a time not far distant to report elsewhere the cases already treated.

CHAPTER XXVII.

MISCELLANEOUS USES OF ELECTRO-PUNCTURE.

WARTS and moles, when they cause disfigurement, or where from any other cause, it is desirable to remove them, may be got rid of by electro-puncture, either by complete electrolysis or by simply forming a coagulum of their albuminous constituents of them. When carefully and properly performed, except in very large growths, no scar should be left, and even in the case of large moles the cicatrix should be very slight. I have operated on a great many cases of these kinds of abnormal troubles, some as a matter of curiosity and some for cosmetic effect, and have reason to be entirely satisfied with the results.

McKenzie in his classification of goitre includes a growth which he calls fibro-nodular; presuming that the cases which here follow come legitimately under that heading, and could therefore not be classed among the various kind of growths before described, I insert them here.

CASES LXXIX AND LXXX.—On November 20th, 1876, Misses N. T. and S. T., twin sisters, were sent to me by my friend Dr. Archer, of Brooklyn. They seemed to be healthy girls, apparently about eighteen years of age. Miss N. T. showed a fibro-nodular goitre involving the isthmus and both alæ of the thyroid. The neck measured 16⅛ inches in circumference. Miss S. T. had a similar growth involving both alæ, but not the isthmus of the thyroid. The

measurement of the neck in her case, was 15¼ inches. On the 21st I used an external application of galvanism on both young ladies, which I repeated daily up to the 27th. On the 27th I introduced into the growth on Miss N. T. two needles, one into the isthmus and the other into the right ala, transmitting thereby a mild galvanic current. I continued the external applications in her case about three times a week up to January 25th. In the case of Miss S. T. the external applications were also continued up to the same date. At that time the measurement of the neck in the first case was 14½ inches, and in the other 13¾.

After this the applications in both cases were made more rarely, about twice a week. On February 9th the measurement in the case of Miss N. T. was 14½ inches, and in that of Miss S. T. 13¼. On March 1st I dismissed Miss S. T., cured; the growth had entirely disappeared. At the same date the tumor on Miss N. T. had not changed as far as the right ala was concerned, but had disappeared from the left ala, and the enlargement of the isthmus had very much decreased. On March 7th I acted on these parts with a galvanic current of medium intensity for twenty minutes, using two needles, one from each pole of the battery. After this the progressive diminution was more perceptible, and at the end of a month the measurement around the neck was 13¼ inches. Part of the growth still remaining, I again repeated the operation last described, and at the beginning of May, had the satisfaction of also dismissing her cured.

Needles used for electro-puncture must be of such a kind to admit of easy penetration of the tissues, and at the same time the material used for insulation must be the most perfect non-conductor possible. It must not be made of too brittle material, that is liable to chip off when the pressure needful for their insertion is made, and it must be insoluble even when imbedded a long time in the tissues. Now I know of no material that fulfils all these indications so well as hard rubber, and such needles are made by Jerome Kidder, of this city, on the manufacture of which he unfortunately holds a patent.

CHAPTER XXVIII.

GALVANO-CAUTERY.

When the poles of a galvanic battery in action are connected by a conductor incapable of transmitting the current as fast as it is generated, the conductor becomes heated, the intensity of the heat being in the direct ratio of the amount of electricity evolved and electromotive force, and in the inverse ratio of the conducting power of the material connecting the poles.

This fact is made use of in the operation known as galvano-cautery, or galvano-causty. A wire or strip of platina is made to join the poles of the battery, and becomes heated to an extreme state of incandescence upon the completion of the circuit. This platina wire or knife, at a white heat, is used to sever diseased growths from the contiguous healthy tissue, to cauterize unhealthy ulcers, sinuses, etc., and to amputate such parts as the tongue, cervix uteri, and other parts which cannot be conveniently reached by the knife, and where a bloodless operation is desirable.*

The advantages this mode of operating possesses over others, in the following conditions, are so apparent that I shall not dwell upon them.

1. Pedunculated tumors.
2. Hæmorrhoids.
3. Sinuses, fistulæ, lupus, etc.
4. Nævi, condylomata, etc.
5. Hæmorrhage from vessels that cannot conveniently be ligatured.

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* All amputations that can be performed by the knife, can also be performed by galvano-cautery; but, except in the conditions above mentioned, it offers no advantages, but many apparent disadvantages. Dr. Paul Burns (England) records twelve amputations performed by it—eight of the thigh, two of the leg, one of the forearm, and one of the finger. Bourdon, of Paris, has used it in eight cases of tracheotomy. Amussat and Verneuil speak highly of it as a substitute for the knife in this operation.

6. Amputation of tongue, cervix uteri, penis, etc.

7. Malignant growths which, from location or otherwise, it is not desirable to destroy by electrolysis.

The battery required for heating a platina wire differs very much in construction from the apparatus required for any other use in medicine or surgery.

In electrolysis some part of the human body is included in the circuit, the resistance of which in ordinary operations varies from 200 to 4000 ohms. In galvano-cautery, at most, only the resistance of ten or fifteen inches of platinum wire has to be overcome, which resistance is represented by .054 to .058 of an ohm. Consequently, in the latter operation we require an apparatus of much less tension. But to develop the necessary heat, a very much larger quantity of actual current than the platinum instrument is capable of transmitting, is essential; therefore, we use an apparatus the elements of which expose a large amount of surface to the chemical action of a very strong exciting fluid. The internal resistance must be a minimum.

It has been the ambition of inventors and surgeons since the time of Middledorpf, to be able to construct such an apparatus which, while capable of heating sufficient metal for an ordinary operation, would combine portability, constancy, reliability, and simplicity of construction. Until the last two or three years the profession have had no instrument in which these conditions were at all approached. Now, thanks to Dr. John Byrne, of Brooklyn, and Dr. H. G. Piffard, of this city, we have cautery batteries which leave nothing to be desired, and will be fully described in a chapter devoted to the purpose. The electrodes required for every-day use are:

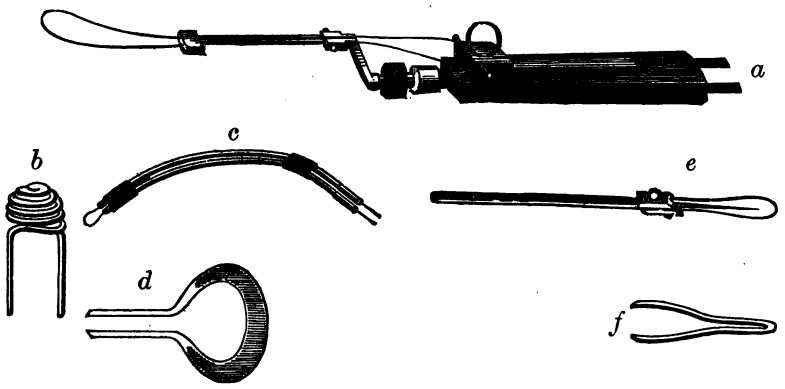
1st. A cautery ecraseur, or handle for platinum wire loop, with a ratchet or other means for tightening the loop, as it cuts through the tissues. Such an instrument is represented at *a*, of the following cut.

2d. Platinum knives (at least two), of different shapes and sizes, shown at *d*, and *e*.

3d. Burners, or moxas; those most frequently needed are represented at *b*, and *f*. Others can readily be made by the surgeon to suit any particular case, from moderately thick platinum wire twisted or bent to the desired shape. Cautery knives are also easily

manufactured in a few moments, as the circumstances may demand them, from strips of sheet platinum, or wire hammered out flat. It is also well to be provided with several platinum wire loops, as it is not an uncommon occurrence for one to break while operating, especially in cutting through fatty tissue, which renders the wire brittle. Beginners may also accidentally melt a wire by using more battery force than is necessary. In operating on the uterus, larynx, posterior nares, and other cavities of the body, an extra long loop-carrier is necessary. The one for the uterus is shown at *c* of Fig. 34.

FIG. 34.



The best-sized wire loop for general use is No. 21, Stubb's gauge, but occasionally the operator will require larger or smaller to suit a particular case.

Dr. John Byrne, in his monograph on electro-cautery, page 61, lays down the following rules for operating. I must here indorse them as valuable axioms. I can neither make addition to them, nor can I strike out any one of them as being unnecessary.

"1. In all cases of induration, destructive ulceration and outgrowths of a malignant nature, or believed to be so, and therefore warranting excision by galvano-cautery, or other means, such operations should never be limited to the apparent line of demarcation between sound and healthy tissue.

"2. When the shape of a part to be excised is such that a loop cannot be made to embrace it, a circular furrow for the reception of the wire may be first made by the cautery knife.

"3. The wire-loop, knife, or other instrument, should never be brought to a white heat when passing through superficial tissues or cellular growths.

"4. Traction on the part should be avoided until the wire has passed well into the submucous structures.

"5. The contraction of the loop should in all cases be very slow and gradual, yet interrupted, so as to secure a thorough cauterization of each stratum passed through.

"6. Towards the close of operations, as the circle of wire becomes small, let the amount of electricity be proportionately lessened.

"7. Apply the wire or knife to the spot intended to be cut before heating."

To give the reader a fair idea of the mode of operating, as well as to allow him to make an accurate estimate of the value of galvano-cautery as compared with the ecraseur, knife, ligature, etc., in similar operations, we will take up for consideration the different diseased conditions in which the cautery may be used with advantage as a substitute for these instruments, with a detail of suitable cases.

PEDUNCULATED TUMORS.

CASE LXXXI.—On June 9th, 1873, I was sent for by my friend, Dr. D. L. Everitt, of Brooklyn, to see a patient of his, a lady aged forty, who was suffering from a fibroid tumor of uterus. Upon examination, I found the growth had a thick pedicle, which took its attachment a little inside the os internum, filling the whole cervical canal, which was dilated to an enormous size, the body of the growth occupying the entire vagina. The patient was extremely anæmic from almost continuous hæmorrhage, the commencement of which dated from about September, 1872. There was general œdema and great debility. Patient had not been out of bed in many weeks, on account of the flow being augmented by the slightest motion. We decided that there was no time to be lost, so appointed the 11th of June to operate. Dr. Pitts having anæsthetized the patient with nitrous oxide, I inserted Dr. Byrne's operating speculum, and after much difficulty succeeded in encircling the pedicle with the wire loop, which was at once brought to a white heat, and a few turns of the ecraseur severed the growth, which was delivered with an ordi-

nary short midwifery forceps. During the operation the flooding was profuse, but after the pedicle was cut through, it immediately ceased, and after this the patient did not lose one drop of blood, and quickly recuperated. I was ably assisted by Drs. Everitt, Hasbrouck, and Woodruff. The length of time the patient was under the influence of the Nitrous oxide was forty minutes. I allude to this fact because it is stated by many physicians that Nitrous oxide is only suitable for very short operations.

CASE LXXXII.—Mrs. S., æt. 40, was sent to me by my friend Dr. Moses, on February 20th, 1878. She had suffered from severe uterine hæmorrhages for over four years.

An examination showed a tumor hanging by a thick pedicle from the fundus of the uterus, filling and distending the uterine cavity to about five inches vertical measurement, by 3½ transversely. Os dilated so as to admit finger, sound could be swept around the growth, and the situation of the pedunculated portion easily ascertained. Gave a favorable prognosis provided the tumor should soon be removed, which the patient consented to.

March 11.—Introduced a large sponge tent into cervical canal.

March 12.—Removed tent and introduced a much larger one.

March 13.—Removed tent. Dilatation sufficient. The patient being placed under the influence of Nitrous oxide by Dr. Glenney, with the assistance of Drs. Mosman and Moses, I surrounded the attachment of the tumor with the cautery loop, heated the loop, and severed the attachment. With a little difficulty the tumor was delivered with an ordinary placenta forceps. Patient made a good recovery.

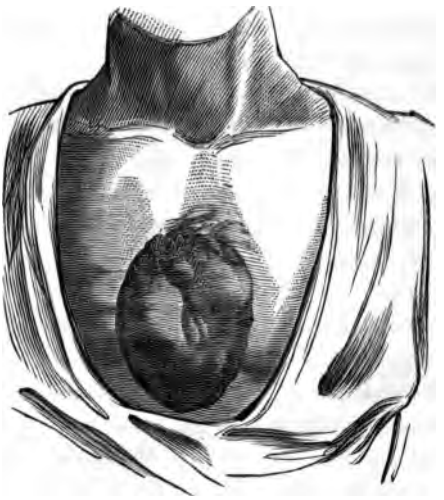
In using the galvano-cautery in the vagina, uterus, nares, mouth, pharynx, larynx, rectum or ear, we must always be careful to avoid burning the adjacent parts by radiation. This end is best attained by protecting the tissues with cotton, wool, or some other substance which is a poor conductor of heat, that may seem specially adapted to suit a particular case. In the removal of growths on the outside of the body, such precautions are unnecessary.

CASE LXXXIII.—Mr. W. T., æt. 26, was brought to my office by Dr. Jennie Ensign, on February 17th, 1877, on account of a large

tumor situated upon the ensiform cartilage, which is shown in Fig. 35. The growth measured four and a half inches in length, vertical measurement, three and a half in breadth, and one and a half in height. It was slightly pedunculated, and had the following history:

At birth, a red mark very slightly raised above the surrounding surface, was all that was visible. This mark, the patient says, was then about the size of a twenty-five cent piece, and was of the shape and color of a strawberry.

FIG. 35.



For a number of years this "mark" increased but little in size; but about six years ago, without any apparent cause, it commenced to grow larger, and continued since to do so, until it reached its present size. Without any hesitation I pronounced the growth to be a large *nævus*, and recommended electrolysis for its removal, to which end, I introduced nine needles into the growth, and attached six of the needles to the negative pole, and three to the positive pole of a galvanic battery, and allowed a current of sufficient power to produce coagulation in a nævus of that size to flow through the growth. But having allowed the current to flow uninteruptedly for several minutes, I saw no sign of coagulation taking place (and nævi are very easily electrolyzed as a general rule; indeed, so easily do

they break down under the galvanic current, that the utmost caution must be used to avoid the production of an eschar, and destruction of the surrounding healthy tissue). But even now no suspicion of the real character of the tumor crossed my mind. I increased the battery current and allowed it to flow for several minutes longer. Still there was no sign of coagulation. I could not make out the reason, so withdrew the needles, desiring the patient to call in a day or two. He called again on the 20th; no apparent difference in the

FIG. 36.

tumor, except the marks of the needles. I then introduced twenty fine needles into the base of the tumor, and divided them between the poles of the battery, and submitted the tumor to the action of a very powerful current for an hour and a half. Still no electrolysis took place, and the patient suffered but little pain either from the introduction of the needles or the action of the current.

February 21st.—Tumor somewhat inflamed; considerable herpetic eruption around the mouth and chin; general febrile disturbance; temperature 105; pulse 120. Ordered *Aconite* every hour; still no electrolysis and no change in size of tumor. It now struck me for the first time, that the growth, although originally an erectile tumor, had undergone fatty degeneration, as fat is the only tissue in the

body that will not yield to electrolysis. I then made up my mind to remove the growth by galvano-cautery.

February 22d.—The febrile symptoms all subsided. Appointed the next day but one to operate.

February 24th.—The patient being anæsthetized with Nitrous oxide gas, by Dr. Hasbrouck, with the assistance of Dr. Ensign, I surrounded the base of the growth with a platinum wire, brought it to a white heat with the cautery battery, and severed the whole lump. An examination of the growth showed that I was right in my diagnosis, the surface of the tumor being erectile while the internal structure had entirely undergone fatty degeneration. Patient did well after operation, wound healing promptly, leaving but little mark, except so far as denuding the part of hair was concerned. The cicatrix is not at all contracted, and is now almost of the same color as the surrounding skin, as shown in Fig. 36.

I would here remark that the cicatrices produced by burns at a white heat do not contract as much as those produced by burns at a dull red heat, or lower temperature.

CHAPTER XXIX.

HÆMORRHOIDS.

Outside of gynæcology there is perhaps no condition which more frequently calls for the use of the galvano-cautery than hæmorrhoids. The removal of piles by galvano-cautery is in my mind by far the most satisfactory operation that can be performed. I have never known or heard of any ill effects following it. Of course, in the hands of a tyro in electro-surgery, we may have trouble from awkward handling of the instruments, such as burning of the adjacent parts by radiation, or even by direct contact, but in the hands of a skilful operator nothing of the kind can happen. There is no danger of phlebitis, pyæmia, septicæmia, or hæmorrhage, as the operation hermetically seals the veins, and for a time disables the absorbents. We can control the action of the cautery instrument with the

same precision that we can the knife, and the ulcer left heals speedily; but one operation is necessary, and the pain after it is trivial. The mode of operating is as follows: The rectum having been cleared by an enema, the patient is placed upon the table in a position most convenient to the operator, and anæsthetized. The sphincter is then to be forcibly dilated, so as to paralyze it for several days. This is done with an instrument made for the purpose, or better still, with an instrument *not* made for the purpose—that is, with the operator's thumbs, both of which are to be inserted into the anus, nail to nail, and forcible traction made in the direction of the tubera ischii, stretching the sphincter with all the force possible, and holding it in this position for some minutes. This process will render the muscle sufficiently powerless not to interfere with the process of cicatrization. The next step of the operation is to seize the piles with polypus forceps, and make gentle traction on them, bringing them if possible below the sphincter. This is easily done if the hæmorrhoids are large, pedunculated, and close to the verge of the anus, and together. Should such be the case, they may be encircled in one loop close to their attachment, the loop heated, tightened, and all severed together. Should, however, the hæmorrhoids be far apart, but still of such a shape as to permit each one to be embraced by a loop, it is better to introduce a trivalve speculum, opening the blades sufficiently far apart to allow one tumor to protrude between them. This one may be operated upon by the loop, and in like manner each one in its turn until all are removed. But should the hæmorrhoids be sessile, imbedded in the areolar tissue, or of such a shape as to render it impossible to ensnare them with the cautery loop, we must then pierce them with a sharp-pointed cauterizer, to destroy their vitality, which it most effectually does. After the operation, I generally dress the parts with calendula cerate, or with a lotion of carbolic acid and oil, and do not allow the bowels to move until the parts heal, which they generally do in about eight or nine days; but this is influenced somewhat by the amount of tissue destroyed, the condition of the patient, and the skill with which the operation was performed. The points to be observed in operating are: 1st. To apply the loop snugly around the diseased tissue before heating. 2d. To tighten slowly, so that the mechanical action of the tightening loop

may not anticipate the cauterizing action. 3d. To protect the adjacent parts from being burned by radiation.

When operating upon large growths which can be drawn below the sphincter, a thick wire about No. 20 is best; but when the loop has to be introduced within the rectum, especially when several piles have to be removed separately, a finer wire (say No. 23 or 24) is preferable for obvious reasons. When the pointed cauterizer is used, it must be fully heated to a bright red heat (not white) before applying it.

For the purpose of comparison, let us discuss seriatim the other surgical means by which hæmorrhoids are ordinarily removed. The principal ones are *excision*, *removal by the ecraseur*, *ligation*, *escharotics*, *injecting the growths with a solution of persulphate* or *perchloride of iron*, or carbolic acid.

Excision.—Only applicable to external hæmorrhoids, and is never thought of by any good surgeon as a means of removing internal piles. It is very seldom, however, that we meet with external piles, without on further exploration finding internal ones also. When we do, there is no objection to excising them; it generally rids the patient of the trouble, and does not give rise to any ill effects: there seldom is any bleeding to speak of. I do not know if we can do any better with the cautery.

Removal by the ecraseur.—This method is practiced by many of our first surgeons. The objections to it are, that we are liable to drag into the instrument a large portion of the surrounding mucous membrane, or we may have secondary hæmorrhage. It is, of course, only applicable to internal hæmorrhoids.

Ligation is perhaps the commonest method in use for the removal of internal hæmorrhoids, but can only be used when the piles are not quite sessile, and imbedded in the mucous membrane. It is objectionable from the fact that the operation may be followed by retention of urine, phlebitis, pyæmia, or septicæmia.

Escharotics should never be used for the destruction of piles, for should we succeed in destroying the hæmorrhoids, which is by no means always the case, we may also destroy a large portion of the surrounding healthy tissue.

Injecting the tumors with persulphate of iron was first suggested and practiced by Dr. Pattison, of London, and in his hands seems

to have been very successful; but in the hands of others it has failed, and in one case in which I tried it was only partially successful. It is, moreover, an extremely tedious operation, and by no means painless, as Dr. Pattison lays down, except to the operator.

Injecting the growths with a saturated solution of carbolic acid and oil.—This is a means of getting rid of hæmorrhoidal tumors recently brought to the notice of the profession. I treated two patients by this means and entirely cured the disease; but in both instances the patients assured me that they would rather have the piles all their lives than submit to the hours of agony that follows such treatment.

The following cases are taken at random from my note-book and are not culled or selected as giving the best results, but are fair examples of the unvarying success I have had in treating this affection:

CASE LXXXIV.—W. P., æt. 23, mechanic, consulted me on June 7th, 1873, relative to large protruding hæmorrhoids, from which he had suffered for some months and which had resisted all medicinal treatment. He complained of continual burning pain, and said that the agony of defecation was so excruciating, that he ordinarily allowed the bowels to remain several days without a movement.

June 10th.—The patient being placed under the influence of Nitrous oxide, by Dr. J. J. Pitts, I removed the whole hæmorrhoidal mass, by the platinum loop ecraseur. The resulting wound was dressed with the ordinary calendula lotion. No surgical shock.

June 11th.—Pulse and temperature normal; appetite good.

June 18th.—Wound healed; patient resumed his business.

CASE LXXXV.—Miss R., æt. 36; suffered for years with internal hæmorrhoids, which very frequently became inflamed and protruded below the sphincter, often bleeding profusely.

June 12th, 1873.—The patient being anæsthetized with Nitrous oxide, I dilated the rectum by means of a trivalve speculum, and removed several small hæmorrhoidal growths separately; some with the wire loop and others with the cautery knife, as convenience required. No after treatment. Bowels moved third day after operation without much trouble or pain. Patient complained of a little soreness in the rectum, which disappeared about the sixth day. This lady has

been under my observation ever since, and still enjoys excellent health.

CASE LXXXVI.—Charles S., æt. 41, applied to me, May 17th, 1876, on account of large protruding hæmorrhoids, which hung from the anus like a bunch of grapes, dragging a large portion of the mucous membrane of the rectum with them. They could not be returned within the sphincter. Sometimes they became strangulated, and gave great pain; never bled much, even when the bowels were constipated. Patient said he could stand them no longer, and at once consented to have them removed by the cautery. Directing him to have the bowels thoroughly cleared by an enema on the following morning, I promised him I would remove them next day.

May 18th, 1876.—The patient being placed under the influence of chloroform by my friend Dr. H. Willis, of Brooklyn, I dilated the sphincter as much as possible, drew the mass well down, and severed the whole at once with the cautery loop. Took the precaution to use means both dietetic and medicinal to insure against a movement of the bowels. With the exception of a little difficulty in urinating, the patient progressed well; complained but little of the pain of the wound, which he said bore no comparison to the pain he had been suffering from the disease. In a few days the wound entirely healed and the gentleman resumed his business, feeling in perfect health, in which he continues to this day (February, 1878), having had in the meantime no return.

CASE LXXXVII.—W. P., æt. 56, was brought to my office by my friend, Dr. A. J. Palmer, of Brooklyn, on April 19th, 1877. On examination I found three large internal hæmorrhoids, which protruded below the sphincter, were not at all tender to the touch but were ulcerated on the surface. Above the sphincter were several smaller ones. Considered the case a favorable one for operation, and so appointed the following day for removal by galvano-cautery.

April 20th.—At 11½ A.M. the patient was anæsthetized with ether by my friend and late partner, Dr. H. G. Preston, and with the assistance of Dr. Palmer, I removed the three larger piles by the cautery loop, and punctured the smaller ones with the pointed cauterizer. The patient made a good recovery.

POLYPI.

Polypus of the nose, larynx, rectum, uterus, and elsewhere may be operated upon and successfully removed by the galvano-cautery. The operation is almost painless, when properly performed, and is recommended by the highest authorities, but for reasons before stated I much prefer to treat them by electrolysis.

FISTULA IN ANO.

This disease is now universally admitted to be one which generally requires surgical interference, although there are cases on record reported to have been cured with Cale. carb., Silicea, Sulphur, Phosphorus, etc., etc. One case in my own practice got well on Silicea, and another on Hepar sulph.

Although we can cure but a small percentage of cases by internal remedies, we can certainly always mitigate the sufferings of the patient and relieve the local irritation by an appropriately chosen drug, and having done so, the patient is in the best possible condition for surgical interference.

When a fistula is of long standing it is lined by a hard cartilaginous membrane, which secretes a fetid pus. To radically cure the disease we must get rid of this cartilaginous pyogenic lining, and disable the ever spasmodically closing sphincter, so that we may have a healthy internal surface to the fistula, capable of filling up by healthy granulations, without hindrance from any extraneous force, muscular action, or otherwise.

Now it is obvious, that whatever course of treatment will bring about this condition in the shortest time, with the least suffering to the patient, and with the slightest amount of destruction of tissue, is essentially the best treatment.

The method I have adopted is as follows: The rectum having been cleared by an enema, I forcibly stretch the sphincter, after the manner before described, and then destroy the pyogenic lining of the fistula by the galvano-cautery. In operating thus, it is best to have the patient under the influence of Nitrous oxide gas. Full anæsthesia is never necessary, as where the galvano-cautery is employed, the pain is only momentary. There is more pain in dilating

the sphincter, and getting the instruments *in situ*, than there is in the quick destruction of the pyogenic lining of the fistula.

As regards the after-treatment, the eschar generally separates about the eighth or tenth day, until which time it is well to use a weak lotion of Carbolic acid and oil. When a healthy granulating surface shows itself in the entire length of the fistula (which may be readily examined by means of a female urethral speculum), *Calendula cerate* or lotion is best as a local application. Should, during the process of healing, the sphincter show any sign of returning contractile power, it must again be forcibly dilated, as at first. The bowels, of course, must not be allowed to act until the fistula is entirely healed, the patient in the meantime being strictly kept in the recumbent position.

Small fistulæ elsewhere, as salivary, small vesico-vaginal, vagino-rectal, etc., may be treated by the galvano-cautery by burning their internal surface, so as to make a slight eschar. The object of this operation is not to destroy the cartilaginous membrane, which only exists as a general rule in fistulæ in ano, but to make a raw surface, which heals by contraction, and thus closes up or tends to close up the abnormal opening.

CHAPTER XXX.

HÆMORRHAGE.

THE hæmostatic effects of the actual and galvano-cautery are so well known, that it is unnecessary to allude to them, except so far as regards some general rules that should always be observed in applying the burners for the purpose of closing the mouths of bleeding vessels. These rules are as follows:

1. The cauterizer should never be heated to more than a dull red heat.

2. It must be made of tolerably thick wire, which will readily retain its heat for a moment or two after the action of the battery is removed.

3. Cleanse the wound or part from whence the blood flows, carefully removing all clots before applying the burner.

4. Cauterize the part freely, not only the mouth of the bleeding vessel, but also a little of the surrounding tissue. Not, however, sufficiently to produce destruction of tissue, but merely coagulation and contraction.

5. Always shut off the current before removing the burner from contact with the wound, as otherwise it sticks to the tissues, and in removal generally drags away a part of the clot which it has formed.

LUPUS.

Only having so far operated on one case of this affection, I am unprepared to offer an opinion as to the value of the cautery as a remedy.

The following is a quotation from an article in the *Charleston Medical Journal*, January 7th, 1877, by Dr. H. G. Piffard of this city:

"In the severer forms of tubercular, ulcerative, and rodent lupus, there can be no question that actual cauterization (where excision is impracticable) is the most satisfactory method of treatment, and is to be altogether preferred to the potential caustics. In several of these cases the results have been extremely gratifying. There is, however, another form of lupus, called by Kaposi the orbicular variety of erythematous lupus, which in an advanced condition is characterized by a ring of infiltrated tissue, inclosing a portion of skin, reddened and perhaps thinned, but not accompanied with ulceration. The tendency of the affection is to extend centrifugally, and to result in atrophy of the portions of tissue involved. The therapeutic indication is to check the extension of the lesion. This may be effected by applying a fine white-hot wire along the outer edge of the infiltration, and burning through the whole depth of the skin; the resulting circular cicatrix will form a barrier across which the lupus infiltration will not extend, and the final result will be a white depressed scar corresponding to the whole of the surface that has been invaded by the disease."

NÆVUS.

Nævi may be operated upon by either thoroughly burning them out with a flat cauterizer, made the size of the growth, or by perforating them in several places with a pointed burner. I have destroyed altogether eleven nævi by the cautery, and must say that as a remedy it does not compare with electro-puncture, and cure by coagulation before described, either as regards results, precision, or simplicity of application. In all my cases but two there was a very perceptible scar left. In all I was obliged to administer an anæsthetic. In three or four I was obliged to repeat the operation on account of the growth being only partially destroyed at the first sitting. It is indeed impossible in large nævi to tell whether we have destroyed the whole growth or not, and in very small ones to prevent more or less destruction of the unaffected tissue. For these reasons I have latterly entirely abandoned it in favor of electro-puncture, which when properly performed can always be relied upon to make a complete and perfect cure. We can control its action with the same precision that we can the knife, there is but little pain produced, and the scar resulting (if any) is much slighter than that produced by the cautery.

CHAPTER XXXI.

AMPUTATION OF THE TONGUE.

Before the introduction of the galvano-cautery, any operation on the tongue that demanded removal of the whole or any part of the organ was dreaded by the surgeon. For if the knife or scissors be used, a deluge of blood immediately follows their application, which no amount of sponging can remove, filling the cavity of the mouth, and hiding all the internal parts from view, thereby rendering the further steps of the operation extremely uncertain. If the ecraseur be employed, a large amount of tissue is liable to be dragged within the instrument that is not calculated upon by the operator, in other

words, its action cannot be controlled with precision. It is, moreover, by no means the bloodless operation it is represented to be, and it leaves a lacerated wound, which takes a long time to heal.

Dr. Bryant,* of Guy's Hospital, who has had considerable experience in the use of the galvano-cautery says:

"There are no operations of importance that the surgeon has to perform which have been more benefited and simplified by the introduction of the galvano-cautery than those upon the tongue; for there are none in which, without its use, hæmorrhage is more troublesome or dangerous, and there are none, with its use, which more satisfactorily illustrates its bloodless character."

When the tip or any transverse section of the tongue has to be removed, it is merely necessary to draw the organ well forward, place a thick platinum loop snugly around it, *cold;* an assistant immerses the plates of the battery in the fluid, and as the wire becomes heated it is *slowly* tightened as it cuts its way through the tissues. In all cases the surrounding parts must be protected from the action of the radiated heat. This point must be specially attended to when the line of excision is far back and inside the mouth. In removing a lateral part of the tongue, the operation is somewhat more difficult, as will be seen from the report of the two following cases.

CASE LXXXVIII.—Mrs. S., æt. 45. Epithelioma of tongue, involving the left side as far back as the anterior pillars of the fauces, and as far forwards as to be within half an inch from the tip. Submaxillary and sublingual glands slightly enlarged. Thinking removal of the disease might afford the patient temporary relief from her sufferings I suggested an operation by the cautery.

September 4th, 1875.—The patient being anæsthetized by Dr. Radcliffe, with the assistance of Drs. H. Willis and E. T. Richardson, of Brooklyn, I cut with the cautery knife well behind the disease to the raphé, and in front of the growth made a similar incision, separating also the lower part of the organ from its attachments in the same manner. I then placed the cautery loop around the part thus isolated, tightened it gradually and severed the whole, thus taking an oblong or square piece out of the lateral and middle part

* London Lancet, vol. i, 1874.

of the tongue. The cheeks and inner part of the mouth were in this case protected with thin pieces of boxwood made for the purpose. There was no blood lost, the wound healed promptly and the patient made a rapid recovery. The disease, however, returned in a few months, as I expected it would, invaded the sublingual and submaxillary glands, and the patient has since died of the trouble.

CASE LXXXIX.—My friend, Dr. H. Thompson, of this city, sent for me to operate on a patient of his, a man 60 years of age, who had a large epithelial growth on the right side of the tongue, extending as far back as in the case last described, and as far forwards as the tip. After consultation, we decided that the best form of operation was first to divide the organ in the centre longitudinally, and then cut outwards, thus removing half of the anterior portion of the organ. To this end, assisted by Dr. Thompson, I introduced a needle armed with a moderately thick platinum wire through the centre of the tongue well behind the disease, and drawing the wire half way through longitudinally, and removed the needle, made the ends of the wire fast in the cautery handle, and tightening the loop so made. The battery was now attached, the loop heated, and the part divided to the tip. Loosening the loop, I next passed it around and behind the growth on the right division of the now cleft organ, heated the wire, and so removed the diseased half of the tongue. The patient made a good recovery, but I understand from Dr. Thompson that the disease again shows symptoms of returning.

AMPUTATION OF THE CERVIX UTERI.

This operation, though usually required for the removal of malignant disease of the cervix, may occasionally be demanded for simple hypertrophy or elongation. The same rules for operating are to be observed as laid down for removal of a transverse section of the tongue. We must be sure, however, when removing a large portion of the cervix, not to place the loop so far back as to include the attachment of the vagina and cervix in it. The patient may be placed either upon the back, or in Sims's position, as may suit the convenience of the operator. Some surgeons, where it is possible, draw the cervix forcibly downwards and outside the vulva before applying the

loop, and operate with the uterus in this position; others prefer operating with the uterus *in situ*. For my own part I certainly give preference to the latter method. It is true that it is much more difficult to surround the neck of the uterus with a wire when in its natural position, than it is when drawn outside. Nevertheless I do not think it justifiable to drag down the uterus and make an artificial prolapsus; straining or even tearing all the attachments of the organ merely to save the operator a little trouble, which certainly is the only advantage (if it can be called an advantage) of this method.

CASE XC.—In July, 1876, in conjunction with my friend, Dr. William T. Helmuth, I removed the entire vaginal portion of the cervix uteri from Mrs. W., æt. 41. The whole cervix was a mass of cauliflower excrescence. The patient had suffered from frequent hæmorrhages for several months, and was very anæmic and weak. The operation was performed thus: The patient being placed upon the operating-table, and ether having been administered by Dr. Dillow, we passed the cautery loop around the diseased cervix, as close to the vaginal attachment as was advisable; heated the loop, tightened, and gradually severed the part. After it was removed, we noticed that a little of the disease was left around the remains of the cervical canal. The destruction of this was accomplished in a few moments by the insertion of a dome-shaped cauterizer, which was used freely. Not a drop of blood was lost. The patient made a good recovery, and in three weeks after the operation attended the Centennial Exhibition in Philadelphia; and, to the best of my knowledge and belief, has remained in good health ever since.

Dr. John Byrne,* in his monograph already alluded to, after giving a detailed account of thirty cases of amputations of the cervix by the cautery, sums up as follows: "In concluding this brief summary of my clinical experience in galvano-cautery, I would simply remark, that those who confine their appreciation of this invaluable agent in uterine surgery to its blood-saving properties, omit to take into consideration its most attractive and important attributes. These consist, first of all, in the peculiar manner in which this hæmostatic effect is produced on the vessels, and which I surmise is

* Pp. 63 and 64.

in no way analogous to that effected by ligature, torsion, écrasement, or styptics. Secondly, there are no disorganized blood-clots or other effete material to become absorbed into the circulation. Blood-poisoning, as I have before observed, need not be apprehended as a sequel of cautery operations. In other words, it would appear that not only are the bloodvessels securely sealed up, but the lymphatics as well, and hence the immunity from hæmatoxic and inflammatory complications."

AMPUTATION OF THE PENIS.

Of this operation Dr. Bryant, in the paper last quoted, says: "This operation in no way endangers life. . . . When performed with the galvanic écraseur the operation is simple and bloodless. . . . The surgeon in performing it is only called upon to be careful to apply the wire well above the disease, and to be slow in the screwing up of the écraseur, having previously satisfied himself that the battery is in good working order, and that the wire employed is at a dull red heat. On the completion of the operation a catheter should be passed and left in; and as the wound heals, a short bougie should be introduced into the orifice of the urethra, to prevent its subsequent contraction. With attention to these points, there is rarely any subsequent source of trouble to be looked for. In all the cases of amputation of the penis (for cancer) that I have performed, or seen performed, much comfort has followed the operation, and with the galvanic écraseur the operation is so satisfactory, that I recommend the removal of the organ when extensively diseased, even when enlargement of the inguinal glands exists, on account of the comfort the operation affords."

MISCELLANEOUS USES OF THE GALVANO-CAUTERY.

The cautery has been used, as first suggested, by Dr. Amussat, Jr.,* for the purpose of destroying the vitality of cystic and other tumors, by perforating them in several places with a sharp cauterizer at a white heat. Such operations are generally successful; but,

* London Med. Record, January 28th, 1874.

for reasons which are quite obvious, electrolytic or electro-catalytic treatment in such cases is much preferable.

The obliteration of varicose veins, is another operation which is successfully performed by the cautery. The vein to be operated upon being fully exposed, the platinum loop is passed around it, the loop heated, and the vein severed. This is generally done at two points in the course of the vessel; that is to say, above and below the varicose part. There is no danger of phlebitis or pyæmia.

Warts, moles, and *skin excrescences*, of all kinds, may be destroyed by the cautery; but from what has before been said, it is almost needless to add that where an indelible cicatrix is to be avoided, treatment by electrolysis is very much to be preferred.

CHAPTER XXXII.

MECHANICAL USES OF ELECTRICITY IN SURGERY.

In cases of partial anchylosis, the faradic current is often a valuable means of breaking up adhesions of an affected joint. By causing the current to act forcibly on the muscles that flex or extend the joint, or in some cases on both sets of muscles alternately, we can gradually tear up the adhesions without much pain to the patient, and in a few seances. In complete anchylosis, however, this is not often possible, as there must be some little capability of motion to expect any benefit from the muscular action.

Adhesions of tendons to their sheaths, or adhesions of muscular tissue to a cicatrix, may be broken up in a similar manner. One of the forms of deafness curable by electricity is that caused by adhesions in the middle ear, the result of catarrhal or other inflammatory disease. The mode of operating on this condition has already been fully described at page 137. The faradic current is the form to be employed.

Adhesions, following iritis, have been treated by electricity with,

it is said, some success; personally I have never used it for this purpose. I must say that I have no doubt if a faradic current could be made to act upon the iris, that is, localize the action of the poles on two points of the muscle, that the desired effect would be produced; but, practically, I do not think that this is possible.

PART VII.

CHAPTER XXXIII.

ELECTRO-PHYSICS.

THERE is nothing so absolutely essential to the electro-therapeutist as a thorough knowledge of all the details of electro-physics, and yet there is no department in medical science more neglected. In a work of this kind it is impossible to present to the readers more than the leading principles, and an outline of the relation it bears to electro-therapy and surgery, and thus give the student the knowledge that he has much more to learn. It is a deplorable fact that there has been and is, far more blind ignorant experimenting in electro-therapy than in any other department of medicine, and most of it owing to the utter want of knowledge of the first principles of electro-physics by medical men. Indeed, socially and professionally, I have met many physicians who had for years been using electricity as a remedy (?), who really did not know how to vary the quantity or tension of the current, and positively did not know the difference between a galvanic battery and a magnetic machine. In these pages I purpose merely to give sufficient of the subject to allow a correct understanding of what I have already written, and to more clearly elucidate the description of the instruments in general use, hereafter described, feeling at the same time that it is almost unnecessary to touch upon the subject at all, there being already in existence so many very excellent works which fully detail the subject; among which I might mention *Electro-physics*, by De La Rive; *Electricity, its Theory and Sources*, by Sprague; and *Electricity and Magnetism*, by Jenkin; all of which should be studied by those who wish to become expert electro-therapists; and no general practitioner who desires to keep up with the knowledge of the present day can afford

to be otherwise than thoroughly conversant with at least one or other of the books mentioned.

In this volume we have only alluded to the use of two forms of current, the galvanic current and the faradic. At the opening pages one mode of generation of the galvanic current was given in detail, and the generation of the faradic current cursorily mentioned. I now propose to go over the subject a little more thoroughly, as far as pertains to the uses of electricity in medicine.

The galvanic current is generated by the chemical action of a fluid upon two metals or substances, one of which is capable of being dissolved by the fluid, and the other not. The metal acted upon is called the positive element, and the one not acted upon the negative. The cup or vessel holding the fluid in which the elements are immersed is called a cell, and a number of these cells and elements constitute a galvanic battery. As the positive element dissolves, electricity is set free (provided the elements either touch above the liquid or are joined or connected with each other by a substance (say a wire) capable of conducting electricity), and travels towards the negative plate, being conducted there through the fluid; the negative plate then conducts it out of the battery to the wire or substance connecting the elements, and the wire conveys it to the positive plate again, so that it will be readily observed the current, whether in or out of the battery cell, always flows in a direction from positive to negative. The junction formed between the elements in this manner is called a circuit, and the parts included in the circuit are, 1st, the positive element; 2d, the exciting fluid; 3d, the negative element; and, 4th, the conducting substance uniting the elements.

Now suppose we sever the wire or connection between the elements, in other words, break the circuit; the current no longer flows, no longer is generated. All evidences of chemical action on the positive plate cease, but as soon as we again touch the severed wires the current is again evolved as at first, and the chemical solution of the positive element proceeds. The amount of electricity generated and evolved from a given cell in a given time may be varied to a great extent by the conductivity of the material connecting the elements; this we will allude to again in a moment.

I have spoken of severing the wire connecting the elements. In such a case the extremities of the wire at the point of severance are

called poles; the one connected with the positive plate is called the negative pole, and the wire joined to the negative plate the positive pole. The reason for this seeming contradiction of terms has already been fully explained at page 12, and need not be entered into again. I have also mentioned the fact that the amount of chemical action in the cell, as well as the amount of electricity generated and evolved, may be made to vary. This fact may be best explained thus: The wire or conducting substance connecting the elements may have a greater or less power of conducting, and hence it is called a good conductor or a bad conductor, as the case may be, or it may be spoken of as having greater or less resistance to the passage of the current. Thick wires afford a more ready passage to the current than thin ones made of the same or equally good conducting material, hence fine wire offers the greatest amount of resistance. These wires or substances connecting the poles, form what is called the external resistance of the circuit, to distinguish it from the resistance of the exciting fluid, which is called the internal resistance. I have mentioned that when the wires connected with the poles were made to touch, the action of the battery was caused. This is always true, but the amount of action may be made to vary according to the differences of the resistances; for example, we will state as a fact, that a battery is generating the greatest amount of electricity, and as fast as it can, when the external resistance equals the internal, and both are at a minimum. That is self-evident, and it needs but little reflection to see that if the external resistance be increased the current does not flow so quickly, and if the internal resistance be increased, as by moving the plates farther apart in the liquid, the current is not generated so quickly as in the first instance. So that as we increase or diminish the resistance of any part of the circuit the amount of actual current traversing that circuit in a given time varies in the inverse ratio of the resistance. The unit by which resistances are measured in this country and in Great Britain is the British Association unit or ohm. In Germany Siemens's unit is most generally adopted. The latter is, perhaps, the most accurate. It is the resistance of a column of mercury at the freezing-point of water, one meter in length, and one millimeter in diameter. The former is measured by an alloy of platinum and silver, and is about one-twentieth greater than Siemens's unit.

Before going any farther with the subject there are three terms which it becomes necessary to explain, these are *quantity, intensity,* and *electro-motive force.*

A quantity of electricity is proportional to amount of the positive element consumed, and depends upon the size of the elements, the strength of the exciting fluid, the electrical affinity of the elements, and is measured by the amount of work it is capable of doing; for instance, a veber of electricity, which is a unit of quantity, is capable of decomposing .00142 of a grain of water.

Intensity is spoken of as representing the amount of power which the current exerts in overcoming the resistance which it has to pass through. The intensity of a current is, according to Ohm's law, equal to the electro-motive force, divided by the sum of the resistance of the circuit, and is expressed by the following equation:

$$I = \frac{E}{R + r.}$$

For the present, to avoid technical difficulties, we will suppose that the intensity of a current and the electro-motive force mean the same thing, only that the electro-motive force represents the force of the energy generated in the battery, reckoned from the positive plate, supposing that no circuit existed, if such a thing can be imagined, and intensity is the amount of energy with which the current is propelled through the circuit outside of the battery.

This, though not absolutely correct, will answer all practical purposes. The unit of electro-motive force is called a volt, and practically equals the force of one Daniell's cell. To increase the intensity of current we use a number of cells, the positive element of one cell being united to the negative of the next, and so on, leaving a positive at one end of the series, and a negative at the other, free to form the ultimate poles.

When the human body or any portion of it is included in the circuit, it is generally essential that a number of cells be used, as the resistance of any tissue in the body is very great, indeed, several million times greater than any of the metals. Some tissues of the body, however, conduct much better than others; when, therefore, we wish to pass a current through a part which is a good conductor, and when the circuit is short, we do not use so many cells to produce

the same effect as when the opposite condition exists. The differences of conductibility of the tissues are about as follows, the highest numbers representing the highest resistances:

Fat,	75*
Bone,	100
Skin,	100
Nerve,	10
Muscle,	6
Cartilage,	20
Tendons,	20
The eye,	4

From this it will be seen that the eye conducts twenty-five times better than skin or bone; nerve tissue ten times; muscular structure about sixteen times, and so on. This fact ought to form at least one factor to guide us in the intensity of the current it is necessary to use in electrizing these parts.

It will probably be noticed in the preceding table that the best conductors are the tissues which contain the greatest amount of water and saline ingredients; this, in a measure, accounts for the fact that young persons are better conductors of electricity than old. To increase the quantity of the current we either use larger elements, or else immerse them more deeply in the exciting fluid, or we can couple the cells positive to positive, and negative to negative, using the free element at each end of the series for our ultimate poles.

CHAPTER XXXIV.

EXPLANATIONS OF TERMS, ACCESSORY INSTRUMENTS, ETC.

Rheostat.—Both quantity and intensity may be reduced by increasing the resistance of the circuit, which may be done by causing the current to pass through an extra or accessory circuit (also called

* These numbers represent the conductivity of living tissue, as dry dead bone, skin and fat are as much non-conductors as dry wood, and during life merely conduct through the amount of water and saline substances held in solution, as in the blood, sweat, etc.

a shunt), or by making the same circuit longer, as by making it pass through an amount of fine wire, water, plumbago, or other badly conducting material. The instrument for this purpose is called a rheostat (from ῥέω to flow, and ἵστημι to stand before), and is a most useful instrument in electro-therapy. It may be graduated from one to several thousand ohms, and insures great accuracy in the use of the galvanic current. Brenner's rheostat is a number of coils of insulated German silver wire, inclosed in a box, on top of which is a regulator, by which any one or any combination of these coils can be included in the circuit. I am now experimenting on the use of plumbago as a means of introducing large resistances in the circuit. So far as I have used it, it answers the purpose admirably, and a rheostat made with it can be manufactured at a much lower price than one with German silver coils.

Density.—Density of current is a term which expresses the degree to which a current is concentrated at a given point, and is thus explained by Lincoln.* "In entering a public building, a crowd grows thicker as the passage narrows; so in passing through a conductor of any sort, the electric current grows denser as the conductor is made smaller."

Anode.—A term sometimes used to denote the positive pole of the battery, from ἀνα upwards, and ὁδὸς the way, used to express the way in which the current ascends from the battery.

Cathode, the negative pole of the battery, from the Greek κατὰ downwards, and ὁδὸς; expressive of the downward flow of the current towards the end of the circuit.

Rheotome is the name of the instrument used to interrupt the current from the Greek ῥέω to flow, and τεμνω to cut. This apparatus is made in a variety of ways; sometimes clockwork is used, by which the number of interruptions per second may be graduated with great precision; this instrument is considered invaluable by some physicians; others prefer one made to work by an extra battery cell and magnet; and others again confine themselves to a simple interrupter attached to the handle of the electrode, and made to move by pressure and release of the finger. All these are useful in their way, but the simple form—that attached to the handle—is the one most often required.

* Op. cit., p. 20.

The Rheotrope is a contrivance by which the direction of the current is instantly reversed, and is derived from ῥέω and τρεπω to turn.

Galvanoscope, Galvanometer. The influence of the galvanic current in deflecting the needle of the mariner's compass has been briefly spoken of.

When the conducting wires from the poles of a battery are passed, one above and one below, and in close proximity to a mounted magnetic needle, the needle becomes deflected from its natural position; the deflection varying in degree according to the strength of the current. Such a contrivance is called a galvanoscope, and is used as a rough guide to indicate the presence of electricity, and the direction in which the current flows. This fact is the basis on which the galvanometer is made. To measure a current of large quantity, small intensity, and slight resistance, a flattened coil made of a few turns of thick wire is introduced into the circuit in such a way that the needle swings freely in the magnetic field formed by the wires of the coil passing above and below the needle, and at the same time parallel to its natural position. The instrument is mounted with a dial on which are marked degrees, or fractions of a degree, whereby to denote and record the amount of deflection. For the measurement of currents which are intense, small in quantity and of considerable resistance, a coil composed of a great number of turns of fine wire is necessary; such a coil is called a multiplier, because it multiplies the number of times the current passes around the needle. Two or three coils made of different thicknesses and length of wire may be made with the same galvonometer in such a way that by a switch any one of them may be at pleasure included in or excluded from the circuit. These constitute the most simple forms of galvanometers, and may be made sufficiently accurate to suit all the wants of the general practitioner.

CHAPTER XXXV.

KINDS OF BATTERIES TO USE.

As we have already mentioned, the galvanic current is generated by chemical decomposition, that the strength of the current varies

in the direct ratio of the amount of that chemical decomposition and the electrical affinity of the elements. From this, as may be readily imagined, we have an infinite variety of battery cells, all differing from each other in electro-motive force; and yet how often do we hear a physician say he used so many cells in treating a certain disease! Knowing the number of cells gives us no indication of the intensity of a current, unless we know the kind of cells, size of elements, strength of fluids, etc.; for instance, one Grenet's cell equals in electro-motive force nearly four Smee's cells, so if a man tells us he used a current from twenty cells, we cannot tell within four hundred per cent. of the dose administered. Now I do not propose to describe all of the varieties of battery cells that have been invented (a description of these will be found in detail in the works on electro-physics before alluded to), nor do I purpose going into the chemical action and reaction that occurs in each cell. Any student understanding chemistry can readily work this out for himself from the data given in the following pages. But all the battery cells that have been found to possess special advantages in therapeutics I here give a short description of, sufficient to give the reader an understanding of the special value of each. Galvanic batteries are divided into two classes, constant and inconstant. Inconstant, means that the battery, when freshly charged, starts with a definite amount of E. M. F., but as the positive plate becomes dissolved by the acid of the exciting fluid, the fluid becomes saturated with the resultant salt, and consequently becomes less acid and less active, thereby becoming gradually a poorer conductor, and so the E. M. F. grows less and less, and finally ceases. But there is another cause for diminution of E. M. F. All single fluid batteries evolve hydrogen, and the bubbles of hydrogen as they come from the positive plate stick fast on the negative, thereby diminishing the surface exposed to the fluid, and producing what is technically known as polarization. *All batteries that set hydrogen free are inconstant. All batteries that do not set hydrogen free, but cause it to effect a chemical combination with some other substance, are constant.*

Constancy, as applied to batteries, means a continuance of the same electro-motive force as long as any exciting fluid remains in the cell. Such batteries are generally two fluid batteries, that is, have a separate fluid in contact with each element. In such, the ele-

ments are either separated by a porous diaphragm, which permits of free endosmosis and exosmosis, or else, the fluids are separated by gravitation.

The following table shows the most approved forms of batteries for therapeutic purposes, and gives the accurate electro-motive force of each as compared with Daniell's, which is taken as the standard:

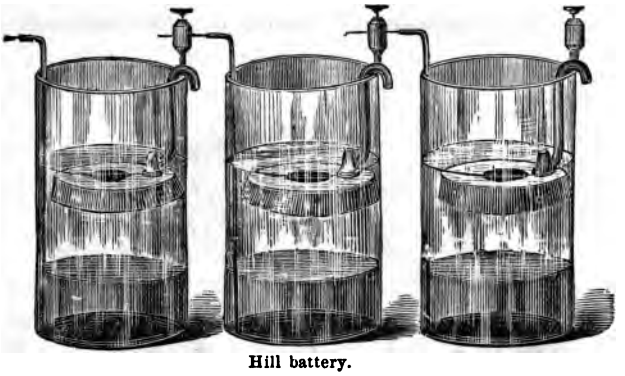
Name of inventor.	Positive element.	Negative element.	Exciting fluid or fluids.	Constant or inconstant.	Electro-motive force.
Smee, ...	Zinc.	Platinized silver.	Sulphuric acid and water.	I	.50
Walker, . . .	"	Carbon.	" " "	I	.50
Beardslee, . .	"	Chromium on lead.	" " "	I	.50
Daniell, . . Siemens and Halske, . Hill, . . .	"	Copper.	Solution of sulphate of copper on negative; sulphate of zinc on positive, with a porous diaph. between.	C	1.00
Grenet, . . Stöhrer, . .	"	Carbon.	Solution of bichromate of potash and dilute sulphuric acid.	I	2.03
Bunsen, . . .	"	"	Carbon in porous cell, with bichromate of potash and sulph. acid solution. Zinc in outer cell, with dilute sulph. acid.	C	1.97
Marie Davy, I.	"	"	Bisulph. mercury and water.	I	1.52
Marie Davy, II.	"	Silver.	Chloride of silver in porous cell, on positive, moistened with salt and water. Outer cell, salt and water on negative.	C	1.02
Le Clanche, . .	"	Carbon with manganese peroxide.	Solution of sal ammoniac.	I	1.56
Byrne, . . .	"	Platina and copper.	Bichrom. potash and sulph. acid.	C	1.99

For therapeutical purposes a constant battery is by all means the most preferable, as by it we can regulate the dose with precision. It is

always ready for action, and requires but little care as far as emptying and refilling are concerned, and of all constant batteries some modification of Daniell's elements answers best. The human body being a poor conductor, transmits but a small quantity of current, consequently the cells need not be large, and the amount of internal resistance is no object, as long as it is not greater than any portion of the body that might be included in the circuit, and, indeed, it is almost practically impossible that such a resistance could be introduced into any ordinary battery cell. For surgical purposes, as for electrolysis, we require a battery which gives more quantity, and in which the internal resistance is not great, and in ordinary operations constancy is not absolutely essential. Almost any of the cells mentioned are suitable. For galvano-cautery we must have a battery possessed of large quantity, moderate electro-motive force, and small internal resistance, as in cautery operations only a small external resistance has to be overcome. We can to a nicety calculate the amount of current that is necessary for such work. To illustrate the matter: A platinum loop, No. 20 Stubbs's gauge, requires exactly a current of fourteen vebers quantity, and eight volts intensity, to heat it sufficiently for operating. Finer wire requires of course less quantity, and shorter, less intensity. To give the directions for arriving at the results of such calculations would necessitate going much deeper into the subject of electro-physics than is the aim of this work, but the student who wishes to fully understand the subject will find everything relating to it in the work of De La Rive, already alluded to. I have said, for purely therapeutical purposes I preferred some modification of Daniell's cell; of these I will mention two, which, in my opinion, surpass all others. They are the Hill cell, as shown in the cut, Fig. 37, in which the fluid in contact with the copper is separated from that on the zinc by gravitation; and the Siemens and Halske cell, as manufactured by the Galvano-Faradic Company of this city, which has a porous diaphragm of clay biscuit, and also a packing of papier maché around the zinc, which, besides acting as a sponge to hold the battery fluid, and keep it from spilling, also diminishes the quantity of electricity set free, by increasing the internal resistance of the cell. The former, of course, can only be used for a stationary battery, as the least jar or movement mixes the

fluids, which at once destroys the action of the apparatus. The latter is equally adapted for both stationary and portable purposes.

FIG. 37.

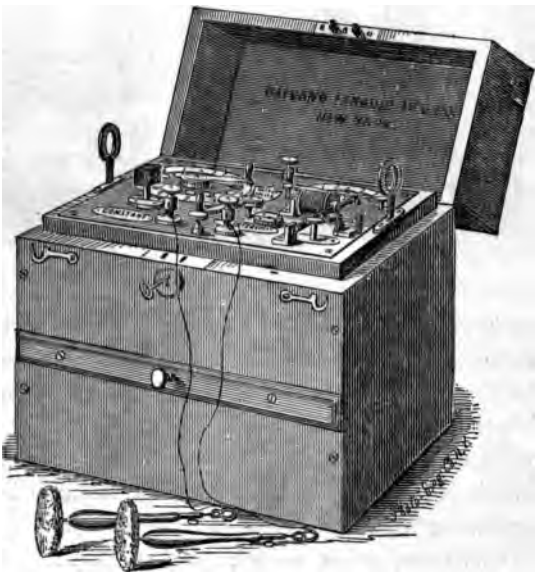


Hill battery.

So far we have spoken only of the construction of the battery cells. There are many other parts of the galvanic battery the construction of which is of importance to the physician. They are, the case in which the cells are contained; the regulator, by which any number of cells can be introduced into the circuit or excluded from it. If a portable battery, the means by which the fluid is prevented from spilling during carriage, the means of immersing the plates, and a great variety of other points. Every galvanic battery for therapeutical purposes should be provided with: 1st. A regulator, by which any number of cells can be introduced at pleasure into the circuit, *one cell at a time.* 2d. A rheotrope, so that the poles can be instantly reversed. 3d. A galvanometer; and 4th. A rheostat. If for portable purposes the case should be strong, and at the same time light. Hard rubber cells are obviously preferable to glass or porcelain. If an inconstant battery is used, it should be provided with a ready means of raising and lowering the elements out of and into the cells; and also a hydrostat, or means of preventing the fluid spilling during transportation. To this may be added, if the taste or judgment of the physician advise it, a rheotome, or automatic current interrupter. Such an instrument is shown in the cut, Fig. 38, manufactured by the Galvano-Faradic Company of this city; and in Fig. 39, one made by Fleming & Talbot, of Philadelphia.

In the first the cells are introduced into the circuit by means of a switch;* in the second, by means of a tight-fitting tag on the end of the electrode cord, inserted into a binding post on one of the elements of each cell, which can be lifted or immersed in sections of ten. With the first-mentioned apparatus, either constant (Siemens

FIG. 38.

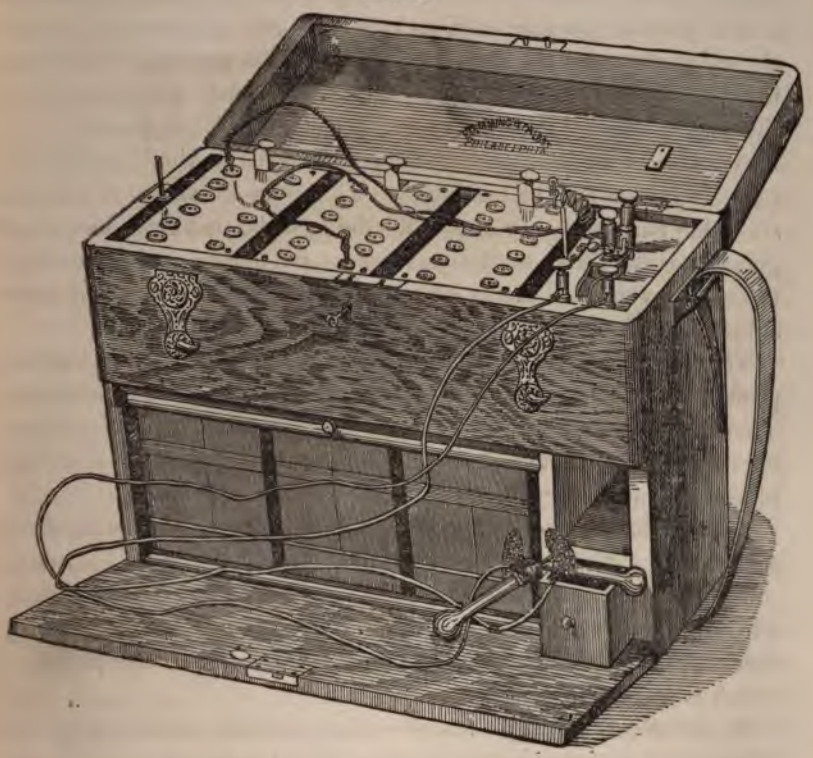


and Halske), or inconstant (Grenet's) cells are furnished, to suit the purchaser; in the latter, Grenet's cells are solely used. They are both valuable instruments, however, and for electrolytic operations, where portability is desired, either of these instruments, furnished with the zinc carbon elements, is as near perfect as any apparatus of the kind can be. For purely therapeutical purposes, for reasons before given, I much prefer the Siemens and Halske modification

* Other arrangements for raising or lowering the elements, as a screw, windlass, or ratchet, may be used; and, for increasing or diminishing the number of cells in the circuit, a slide may be employed, or any other mechanical device, according to the taste of the inventor or manufacturer. The two instruments just described are mentioned as being in my estimation more perfect and simple than any other portable batteries I have yet seen.

of cell, as in the first instrument. Both instruments can be made with any number of cells that may be required. The E. M. F. of the zinc carbon cell, when used with bichromate solution, is just double that of the Siemens and Halske element; so that, where we would want one of the former, we require two of the latter. The

FIG. 79.



quantity of the zinc carbon cell multiplies by many times that of the Siemens and Halske element; that is, of course supposing that the elements in each case expose the same area of surface to the respective exciting fluids. Should, however, the zinc carbon element be excited with dilute sulphuric acid, instead of the bichromate solution, the E. M. F. becomes reduced to one-fourth; so that one cell with zinc carbon elements, excited by bichromate fluid, is equal in E. M. F. to four of the same cells excited by sulphuric acid and water.

CAUTERY BATTERIES.

For the purpose of heating wire, we require, as before mentioned, a battery of entirely different construction from that used to exercise effects on the animal economy. It must be distinctly borne in mind that the current used for heating metal in cautery operations is used *for that purpose only*, and that the current does not exercise any effect whatever on the part with which the cauterizer is brought into contact, except through the influence of the heat produced in the metal. Could the metal be heated and kept hot when brought into contact with the flesh, by any other means, it would answer the purpose just as well as electricity. It may seem useless to many to state this fact; my only reason for doing so is, that the operation of galvano-cautery and electrolysis are so often confounded one with the other by medical men who have not given much attention to the subject.

There have been, from time to time, brought to the notice of the profession various apparatus for the purpose under consideration. There are only two, however, that practically are worth considering; those are Byrne's battery and Piffard's modification of the platinum zinc battery.

Byrne's Battery.—The following description of this perfect little apparatus I give in as nearly the inventor's own words as possible:

It embodies in its construction a newly-invented negative plate, whereby the advantage of a platinum surface, which is very highly electro-negative, is combined with the advantage of a copper plate, which is eminently conductive.

By this combination an intense action is produced, with much less resistance than in any other negative plate; consequently a greater quantity of current is developed, and of course, thereby greater heating effect. This negative plate consists of a sheet of platinum, attached by its whole surface on one side to a plate of copper, and the copper in its turn is backed by a thin sheet of lead, which is varnished, so that only the platinum face of the plate is exposed. A single cell, composed of two of these plates, with a zinc plate for the positive between, immersed in bichromate battery fluid, and exposing twenty-two square inches of surface to the action of the

fluid, gives an E. M. F. of 1.99, and a quantity equal to that of about thirteen Daniell's cells, with an internal resistance of about half an ohm. The cautery battery is composed of four such cells, and the electro-motive force when united for intensity, is 7.96. By means of screws on the rubber platform, to which the elements are attached, it can be arranged so that the quantity can at any time be doubled at a sacrifice of half the electro-motive force. This is a great acquisition, as by its means we can heat thicker wire, such as knives and burners are made of, which are short, and do not require so much electro-motive force as the long wire used in the loop.

The heating power of this apparatns is very great. When combined for intensity, it will heat sufficiently for operating 18 inches of No. 18 platinum wire. When combined for quantity, about half that length of double the diameter.

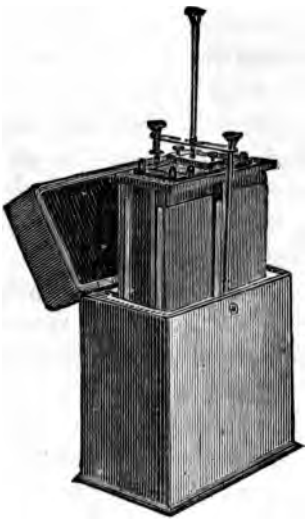
So far as we have described the instrument, it is inconstant, and would polarize almost immediately on the circuit being closed on so small a resistance as a wire loop or burner, so that the wire would not remain hot more than a few seconds. To obviate this defect a rubber bulb provided with tubes, one for each cell, is used to blow air through the fluid, keeping it in a constant state of commotion, and thus preventing hydrogen bubbles forming or remaining on the face of the negative plate. This arrangement changes the inconstant battery into a constant one, without at all increasing the internal resistance, or lessening its action in any way. It may be used for the most tedious surgical operation without any appreciable loss of strength. The instrument, which is inclosed in a mahogany box, and measures $8\frac{1}{2}$ x $7\frac{1}{4}$ x $4\frac{1}{8}$ inches, is shown in the following cut, Fig. 40.

The Piffard Cautery Battery consists of six cells. Each cell has a thin plate of platinum for the negative element, which is suspended between two plates of zinc, bichromate fluid forming the exciting medium. It is of about the same electro-motive force as Byrne's instrument, the two additional cells being needed on account of the greater resistance of the thin platinum foil. The blower is not used in this battery, polarization being avoided by rocking the platform to and fro, and thus moving the elements attached to it in the liquid, which on each movement flows freely through the holes in the zinc,

and so washes the hydrogen bubbles as they form from the surface of the platinum.

It can be combined for quantity or intensity by the same arrangements as Byrne's battery, and has about the same heating power.

FIG. 40.



The Byrne Cautery Battery.

It is about double the size, each cell holding about three times the quantity of fluid. The objection that has been made to it is, that on account of its greater internal resistance and large zinc surface, the fluid becomes heated.

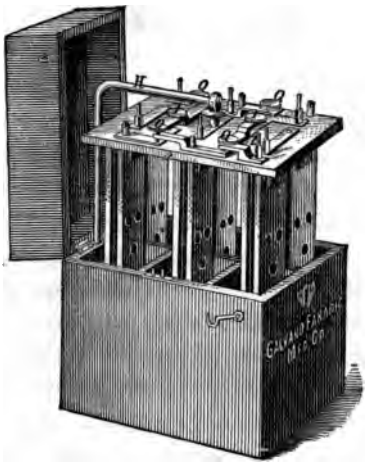
I do not think this a serious objection, as this fact in itself tends to lessen that resistance, as fluids when warm conduct better than when cold. The instrument is shown in Fig. 41.

Although I give preference to Dr. Byrne's battery, having many obvious advantages, among which I may mention lightness, compactness, lesser consumption of fluid, etc., I must say that no operation can be performed with one that cannot be done with the other.

No battery can remain absolutely perfect, as part of it is being consumed all the time it is in action, and from splashes of fluid on the connections, and other causes, the most simply constructed instrument is liable to get out of order. Dr. Byrne, in his book already

quoted, says: "It will be found impossible to construct any galvano-electric apparatus which may not occasionally become defective, either by accidental displacement of some of its parts, or imperfections resulting from use, etc. . . . . Consequently, no surgeon can

FIG. 41.



The Piffard Cautery Battery.

hope to succeed in the practice of electro-cautery unless when difficulties arise, as in the case of not obtaining sufficient heat, he is not only competent to fully appreciate and understand the nature, causes, and extent of such interruptions, but also possessed of a certain amount of mechanical aptitude, so as to enable him to remedy the defect. Indeed I have no hesitation in stating that these conditions are essential to success, and cannot safely be dispensed with, because, though certain rules can be laid down concerning the general management of batteries, and even specific directions given as to the proper method of conducting cautery operations, nothing short of a tolerably exact scientific knowledge of the whole subject will suffice to overcome unavoidable obstacles."

This is absolutely true, not only of galvano-cautery, and cautery batteries, but of every department in electro-therapy and surgery, and of the instruments used in these several departments.

CHAPTER XXXVI.

INDUCED CURRENTS.

A CURRENT flowing from a battery cell, or cells, made to traverse a wire which is coiled around and made to inclose a bar of soft iron, causes a momentary current in the coil, at each break of the circuit, infinitely more intense though less in quantity than that generated in the battery, and flowing in the opposite direction to that of the generating force, and if over this coil be wound another coil of finer wire, entirely insulated from the first, another current is caused to flow, at the break of the current, in the opposite direction to that of the first coil, and in the same direction as that of the battery cell; at the make of the circuit, in the same direction as that of the current from the first coil, and in the opposite direction to that of the battery; and so on we may superimpose coil over coil, and in each instance we induce a new current in the last added coil, infinitely more intense than the last, at the break or interruption of the circuit, and equal to the current of the last coil at the make.

So we have a momentary to and fro current as long as the circuit continues to be interrupted.

Another effect of this experiment is, that the bar of soft iron, sometimes called the core, becomes magnetized during the continuance of the generating force, and loses its magnetism at each discontinuance. This fact is made use of in a way which we shall see presently.

This magnetism varies in strength in the direct ratio of the number of turns of the wire around the core. In other words, the longer the wire of the coil the more intensely magnetic the core becomes, and the more intense and dense the current induced; although the resistance of a long coil is manifestly greater than a short one. This would seem to contradict the law previously given, as regards galvanic currents, viz., that $I = \frac{E}{R+r}$. A moment's reflection will, however, explain this seeming contradiction. We must recollect we have an extra force generating the induced current, and that is

the magnetism set free from the core; and as I explained just now, the greater the magnetic force the more intense the current induced; but in order to make the magnetic force strong, the number of turns around the core must be many. So although the resistance to the primary battery current becomes greater at every additional length of wire added to the coil, still the power added to the magnet more than makes up for it. For these principles we are indebted to the researches of Faraday, and after him currents generated in this way are called faradic, and the use of this current faradization.

Most of what is useful in electrical science outside of therapeutics owes its origin to the facts just stated; and in therapeutics the induced current is used at least twice as often as the primary or galvanic. It is evident that upon the principles laid down, almost an endless variety of electro-magnetic machines might be constructed, differing from each other in quantity, intensity, density, magnetic force, frequency of interruptions of circuit, etc., etc. Indeed there are infinite variety of induction machines on the market at the present day, some of them meeting most of the requirements of every-day practice, some of them sadly defective. Few of them, however, fulfil all requirements of electro-therapeutics.

An induction machine must consist essentially of six parts:

1st. The primary source of power, *i. e.*, the galvanic cell or cells, which must be reliable, sufficiently constant, and must generate a current suitable in quantity and E. M. F. to the size and length of wire composing the primary coil.

2d. The primary coil or helix, which must be made in proportion to the quantity and E. M. F. of the inducing current. The larger the wire the larger the quantity of current. Surrounding this, but in no way touching it, is wound—

3d. The next or secondary coil, and over this may be wound other coils in the same manner.

4th. The core, made either of a bar of soft iron, or, better still, of a bundle of soft iron wires. Surrounding this is—

5th. The graduator, generally a non-magnetic metallic tube, of a sufficient size to inclose, but move freely upon the core. When this tube entirely covers the core the current induced in the coils is almost at zero; and as it is withdrawn, the magnetism from the core is exercised upon the coils in proportion as the core is uncovered by the

withdrawal of this tube, as only the exposed part of the magnet acts in inducing.

6th. The rheotome. This is generally an armature of soft iron attached to a spring, and included in the circuit; and as the current is closed the core becomes magnetic, attracts the armature towards it, and away from its connection in the circuit; this act, breaking the circuit, causes the momentary induced current to flow, but it also demagnetizes the core, and the spring asserts its power and draws the armature back into its connection in the circuit, and the core becomes magnetized once more, and so the armature is made to move backwards and forwards, making and breaking the current automatically. The frequency of the interruptions can be regulated with precision by the mechanical arrangement attached to this armature, and no machine can be considered perfect which has not a means of regulating the frequency of interruptions from a series of vibrations (a mere hum in fact) to one or two a second.

These, with the stand or case, may be called the essentials of an induction machine.

The most perfect induction machines are those that are most easily put into and taken out of action, that admit of the greatest range of quantity and intensity, the facility with which these can be altered, and permit a ready means of arranging the frequency of the interruptions to the widest scope. Some makers' instruments possess one essential and some another, but none that I know of the whole, each one having patented some one essential point, which is jealously guarded, so that to get all the possible merits combined in any one machine is wellnigh impossible.

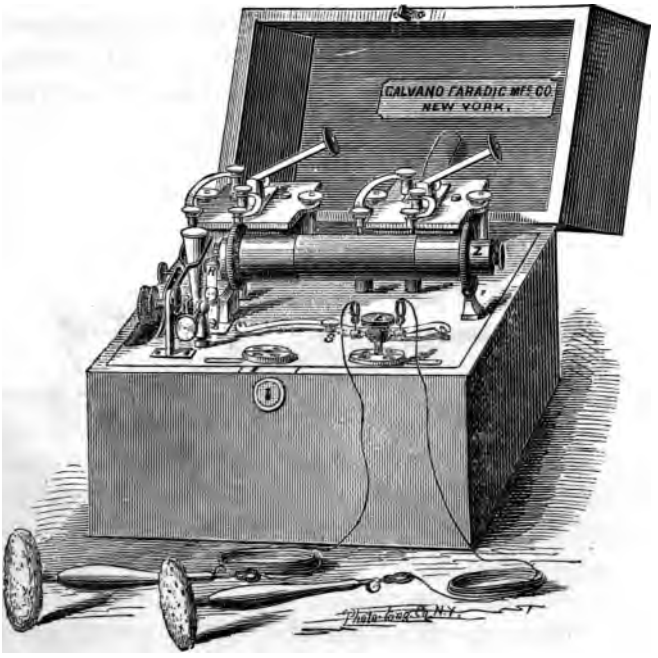
I will describe a few of what appears to me to be the best apparatus that are now obtainable, so that from what I have here already written the student will find no difficulty in selecting one to suit any definite purpose he may have in view.

The instrument depicted at Fig. 42 is manufactured by the Company whose name it bears. The inducing power emanates from a pair of Grenet's cells, each of which is provided with a hydrostat or water-tight cover for the cells, which renders the instrument capable of being readily carried about without danger of the liquid being spilled. The primary coil is composed of four layers of No. 22 wire, and the secondary of No. 32. The core is a bundle of soft iron wire,

made fast at one end to a brass ring attached to the board forming the support of the helices.

The instrument is provided with two rheotomes, one, which gives only the most rapid vibrations, and is called a trembler, and another, which can be adjusted either for moderately quick, or else

FIG. 42.



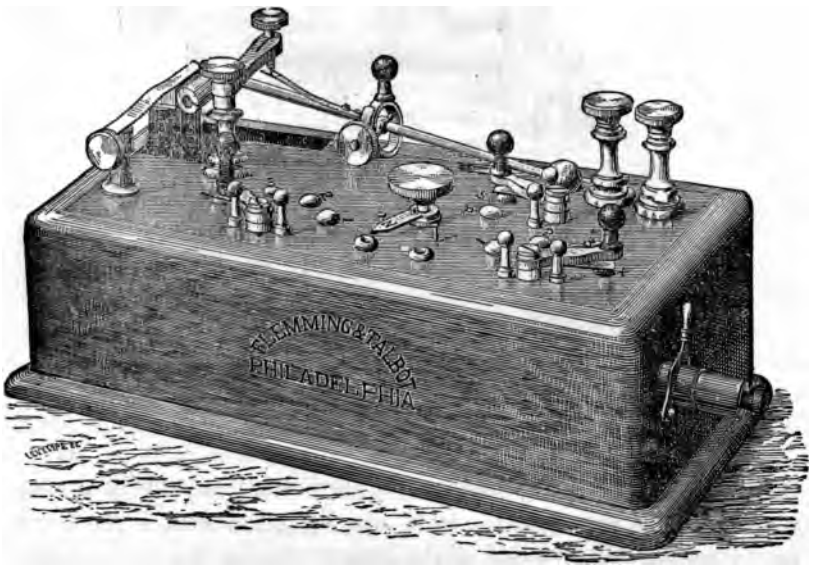
very slow interruptions; perhaps the slowest it is capable of giving is two or three per second. It is also furnished with a rheotrope for reversing the direction of the current, but as, in induction currents, polarity and direction of current are only comparative terms, representing a to-and-fro current that is stronger in one direction than another, I do not consider the rheotrope any very great acquisition. Now if this Company, or any other, would devise an automatic rheotrope which would reverse the inducing current so as to make it flow in the same direction as the induced, they would confer a lasting benefit upon the profession at large.

Since writing the above, I have been informed that this Company

now construct an instrument with four coils, having two divisions to the primary, and two to the secondary.

Another induction apparatus, which I value very highly, is shown in Fig. 43, and in a portable form, inclosed in a box, in Fig. 44. The instrument has all the advantages of that one last described, with the addition of a number of separate lengths of coil, any one of which can be let into or shut out of the circuit by a switch, at pleasure. This machine is worked by a single bichromate cell, and is as reliable and easily handled as any on the market, giving quite sufficient intensity for any case, and as large a quantity as is possible to produce in an instrument of that size.

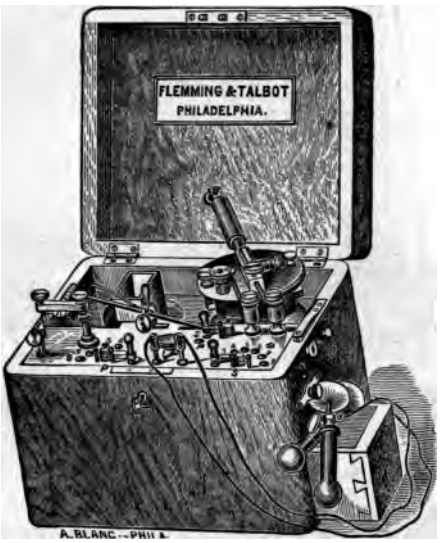
FIG. 43.



A very excellent inductorium is manufactured by the Western Electric Manufacturing Company. It has two Grenet's cells to generate the inducing force, either of which can be used separately, at the pleasure of the operator; or both can be combined when high tension is required. There are two coils, a primary and secondary, the latter of which is wound to a resistance of one hundred and fifty ohms. The rheotome, however, has no means of being graduated to

very slow vibrations, as in the instrument previously described. This Company has recently constructed for my friend, Dr. Tooker, of Chicago, an instrument after this pattern, with ten superimposed coils, each one made of a different length and thickness of wire. Dr. Tooker has kindly written to me describing the instrument, and says

FIG. 44.

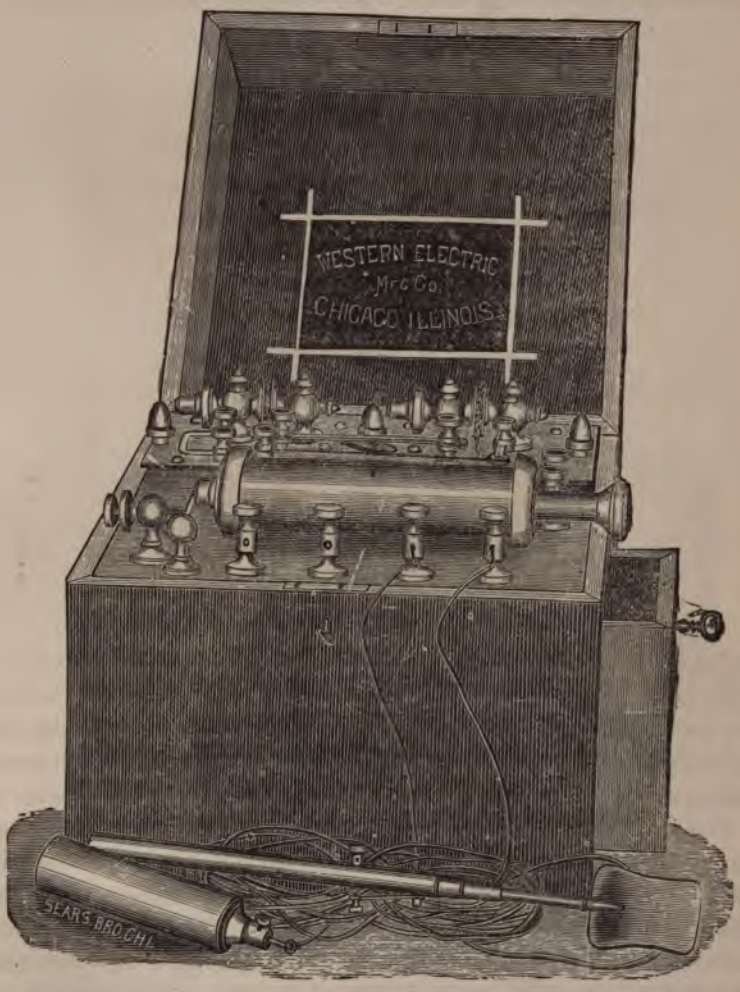


he values it very highly, and bears testimony to the fact, previously stated in this work, that some diseases will yield to a current induced in a very fine coil (high attenuation), that will entirely resist the action of a current of larger quantity, and *vice versa*. The instrument with two coils is shown in the following woodcut, Fig. 45.

Among the most recent inventions in this line I may mention one by Dr. C. H. Rae of this city. It is an induction machine with two distinct and separate coils, the inducing force for which is furnished from a pair of medium-sized Smee elements. The first coil is constructed in the ordinary way, that is to say, with primary and secondary wires. The current from the second coil is induced by attaching the secondary wire of the first coil to the primary of the second; this furnishes the inducing force for the secondary wire of the second coil, to which he gives the name of the superinduced

current. The intensity of the current is controlled by movable cores, which are partially withdrawn from the helices when we wish to lessen the force. The rheotome is worked by a separate magnet

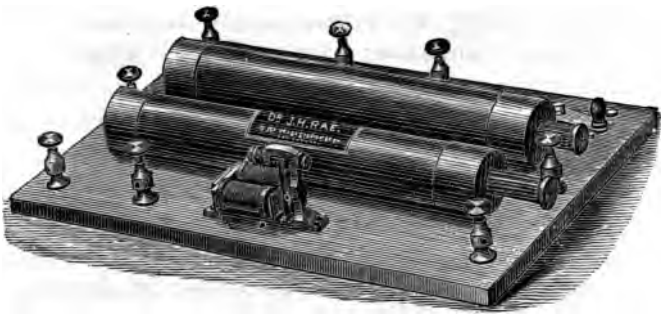
FIG. 45.



included in the circuit. There are no means of producing very slow interruptions. The instrument furnishes a very steady current, and certainly as much variation of effect as any other machine with pri-

mary, secondary, and tertiary coils. At the same time, I must say that the superinduced current obtainable from the second helix in no way differs from that which is produced in a machine with one

FIG. 46.



coil and a third current induced from a tertiary wire. It is, however, convenient for office use, and perfectly reliable. The apparatus is sold by Messrs. Boericke & Tafel.

These instruments are, as far as my experience goes, the best in general use. For my own use I have had one made with a number of coils, the first coil being made of No. 14 wire, and the last 36. It is worked by a single Grenet cell. Any one of these coils, which are of course wound on the same core, can be used separately. It may not be out of place to here give a fact or two relative to the therapeutical action of currents induced in different-sized wires.

In any case where muscular irritability is impaired, it is a well-known fact that a muscle can be made to contract under the stimulus of the galvanic current, where the faradic or induced current meets with no response whatever. Now it is equally a fact, though not so well known, that there are also cases where a muscle having lost some of its irritability, can be made to respond to a faradic current induced in a large thick wire, that shows no sign of contraction when a finer current is transmitted. This fact is perhaps best exemplified in an ordinary case of Bell's paralysis undergoing gradual improvement. At first the paralyzed muscles respond only under the stimulus of the galvanic current; as improvement goes on they begin to show signs of contraction to a faradic current from a thick wire, and finally, as they recover tone and strength, to the finer coils, which

at first have no effect. On the other hand, we often find cases in which the galvanic current and primary faradic produce serious aggravations, that are immediately benefited by a fine current from a third or fourth coil.

There are a variety of other faradic apparatus, a few of which deserve special mention, but as those already mentioned contain the points of these, and something more besides, it is unnecessary to describe them in detail. Jerome Kidder, of this city, is the inventor of an induction machine, which is composed of different lengths and thicknesses of wire, but continued in one coil. The current from any one of these sections can be used at will; some of his machines have as many as six variations of density of current. The instrument is worked by a single Smee cell, which can be readily set into action by partially inverting it. The rheotome, however, gives nothing but the most rapid vibrations. It is very simple in its construction, and does not easily get out of order.

Curt Meyer, of Broadway, makes an induction coil that is easily manipulated, and yields a very smooth current. The secondary coil being wound to a very high resistance, gives a current of great tension. This coil can be worked with any battery, but a single Smee cell is sufficient for ordinary therapeutical effects.

Thomas Hall, of Boston, manufactures an instrument in which primary and secondary currents can be obtained, or both coils can be combined so as to form one long primary coil.

Gaiffe's pocket battery is a valuable little instrument to have on hand in emergencies. The battery force is supplied by two or three Marie Davy's cells, and the little coil furnishes primary and secondary currents. The rheotome is the ordinary trembling armature. Only the finest currents are obtainable from it.

Outside of these I know of no induction instrument that contains any points of special advantage.

CHAPTER XXXVII.

STATIONARY BATTERIES.

So far I have only described batteries and induction machines which are portable, and more or less imperfect, as far at least as furnishing every variety of electric current that is necessary in therapeutics. Perfection and absolute accuracy in detail are not possible in an ordinary portable instrument; I mean by this, that it is impossible to construct a single instrument, which a physician can carry around in his carriage, that will furnish a *constant* galvanic current of sufficient electro-motive force to meet the requirements of all cases, and that will at the same time admit of nice adjustment as to accuracy and precision in regulating the exact dose administered, and of measuring the same, and at the same time furnish every modification of that current as to interruption, reversal of direction, etc., and in the same case have inclosed an inductorium which will give all the varieties of the faradic current which are needed in practice. Such an instrument is absolutely essential in the office of the specialist, and should consist of a battery of at least fifty to seventy of some modification of Daniell's elements, large enough not to need very frequent refilling or looking after. These should be connected with the regulator in such a way that any one or any number of the cells could be at pleasure introduced into the circuit. A reliable galvanometer, not attached to the instrument, however, but capable of being introduced into the circuit and removed at will, is the next necessity. A rheostat of at least 3000 ohms (not a water moderator), which is easily manipulated; one with plugs is perhaps the best, by withdrawing any one of which, a definite and known resistance can be included in the circuit. Next in order are, an automatic rheotome, by which slow or quick interruptions can be made; and a rheotrope, or polarity changer, by which the current can instantly be caused to reverse its direction. These accessories are all essentials in using the galvanic current. On the same regulator we must have a faradic coil, worked

by a separate cell or cells, capable of giving every variety of current; a large number of different-sized superimposed coils are desirable, if not absolutely necessary. Such an instrument may be made in cabinet form to suit the taste and judgment; or the battery cells may be placed in a cellar, adjoining room, or elsewhere, and connected by wires with a regulator fixed on a stand in the operating-room. I will describe two instruments which seem to fulfil most requirements.

The first instrument, delineated in Fig. 47, has a battery of sixty Siemens and Halske cells, and all the requirements above mentioned

FIG. 47.

except the number of different-sized coils for the induction currents. These, however, can be readily added to the apparatus without otherwise altering it.

The second apparatus, Fig. 48, is somewhat more elaborate. It can be provided with any kind of cells, or any number to suit the purchaser. The regulator of the instrument contains, at the rear on the right, an automatic rheotome, for interrupting the galvanic cur-

FIG. 48.

Flemming & Talbot's Cabinet Battery.

rent once, twice, four, or eight times a second; in the centre, a galvanometer, and on the left a wire rheostat for introducing any desired resistance to the current, the register on the face representing 2100 units, Siemens's resistance. In front of these are scales for bringing any number of cells of the galvanic battery into action, and on the left is a water rheostat. In front is the faradic apparatus, provided with a slow and a rapid interrupter, and switches for connecting with the primary or secondary current. The outer, secondary coil of the apparatus is worked by a governing screw, which regulates the tension of the two currents. On the left front is a commutator, connected with both the faradic and galvanic apparatus, by which the polarity is reversed or the current interrupted by hand, and in front of this are the binding posts, for receiving the conducting cords, which pass through the platform and come out of one of the drawers.

The only objection I have to these instruments is the galvanometer, which does not denote the strength of the current with the same accuracy as the galvanometer previously described. Moreover, this accessory ought to be movable, as the needle must be influenced in a great degree by being in proximity to the iron core of the inductive part of the machine, which is the objection to having a galvanoscope or galvanometer attached as an immovable fixture to a cabinet battery.*

CARE OF BATTERIES.

Now a few words on this subject, and I have finished. Many physicians imagine that all they have to do is to purchase a battery and fill it with fluid, and it will take care of itself. A moment's reflection will show us that such is an impossibility. Indeed, the care of a battery is by no means a sinecure. Chemical action goes on all the time the elements are in action, and in some instruments to a considerable extent when not in action also; consequently the salts resulting from such decomposition are liable to creep over the cells and on to the connections, which at once may not only impair the power of the instrument, but stop its action altogether, and

* Of course these instruments are only intended for purely therapeutical purposes, and do not furnish quantity sufficient for electrolytic effects.

would eventually destroy it. This is most likely to occur in Daniell's battery and its modifications, and is the only objection that can be offered to them. A little care will avoid this, however. As long as the specific gravity of the fluid is kept below 40° there is no danger of this taking place, so all that is necessary is to test the specific gravity every few days with a hydrometer, and take out a little fluid with a syringe or siphon, if it shows a tendency to go above that point, and then add an amount of water equal to the quantity of fluid removed. *The connections of all batteries must be always kept scrupulously clean and bright.* In most batteries the zinc must be amalgamated, that is, covered with a coating of mercury. The reason for this is obvious. However, for the enlightenment of beginners, an explanation may be desirable.

If the zinc plates could be obtained perfectly chemically pure, and of equal hardness throughout, there would be no occasion for this process, but the zinc plates used for batteries never are; and as not only the metals which exist as impurities, but also the hard and soft parts of the zinc itself, set up a number of little batteries on their own account, thereby not only weakening the current, but also using up the elements and fluid unnecessarily, it is necessary to use some means to prevent this action taking place. Covering the plates with pure mercury effectually does this, and only allows the fluid in which the zinc is immersed to attack the plates when the battery circuit is complete.

Another point that must be attended to in the management of batteries is never to leave the instrument on a close circuit when not in actual use, and, with an inconstant battery, the plates should only be immersed in the exciting liquid *when in actual use.* Carbons are liable to become saturated, that is, to have the salts of the fluid crystallize and harden upon them, which weakens the electro-motive force. When such takes place they should be removed and soaked in warm water.

Platinum plates sometimes become electro-plated with a deposit of metallic zinc when used with zinc plates that are imperfectly amalgamated. When this takes place, as it often does in cautery instruments, they must be disconnected from the battery, and soaked in dilute nitric acid, about one part of acid to five of water.

In this connection it is well, perhaps, to give the prescriptions for making the exciting fluids for different forms of batteries:

Smee Battery, ...	℞.	Sulphuric acid, fort., . . .	℥j.
		Water, ...	℥x.
		M. and allow to cool.	
Grenet, ...		Bichromate of potash, . .	℥viij.
Bunsen, ...		Water, ...	Ov.
Stöhrer, ...		Sulph. acid, fort., ...	℥viij. M.

For cautery purposes this may be made one-fourth stronger. For the Daniell's battery it is merely necessary to fill the outer and inner cell with water, and place in the cell containing the copper element a much larger amount of crystals of sulphate of copper than the water is capable of dissolving. The action of the battery in a little while sets free sufficient sulphuric acid to act on the zinc. In case the battery is required for immediate use after filling, a few drops of dilute sulphuric acid in the cell containing the zinc will hasten the commencement of action.

The same rule holds good for the Siemens and Halske battery. For the Hill battery, where no porous cell is used, it is best to put into the vessel dry crystals of sulphate of copper, and then pour in the water, or a weak solution of sulphate of zinc, avoiding agitation.

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Tobold.

Valentine.
Valleix.
Volta.

Waller.
Wells.

Ziemssen.

ERRATA.

Page 24, 8th line from foot of page, for "fulness" read "fullness."

Page 41, line 15, for "aumorosis" read "amaurosis."

Page 44, line 23, for "repitition" read "repetition."

Page 44, last line, there should be a "comma," instead of a "full stop," after "affection," which materially alters the sense of the sentence.

Page 50, line 9, for "typanum" read "tympanum."

Page 65, line 3, for "resort" read "ressort."

Page 74, 3d line from foot of page, for "curoatua" read "curvature."

Page 75, line 18, for "24" read "20."

Page 116, line 4, for "is" read "are."

Page 116, line 5, for "has" read "have."

Page 117, footnote, for "Tiemmsen" read "Ziemssen."

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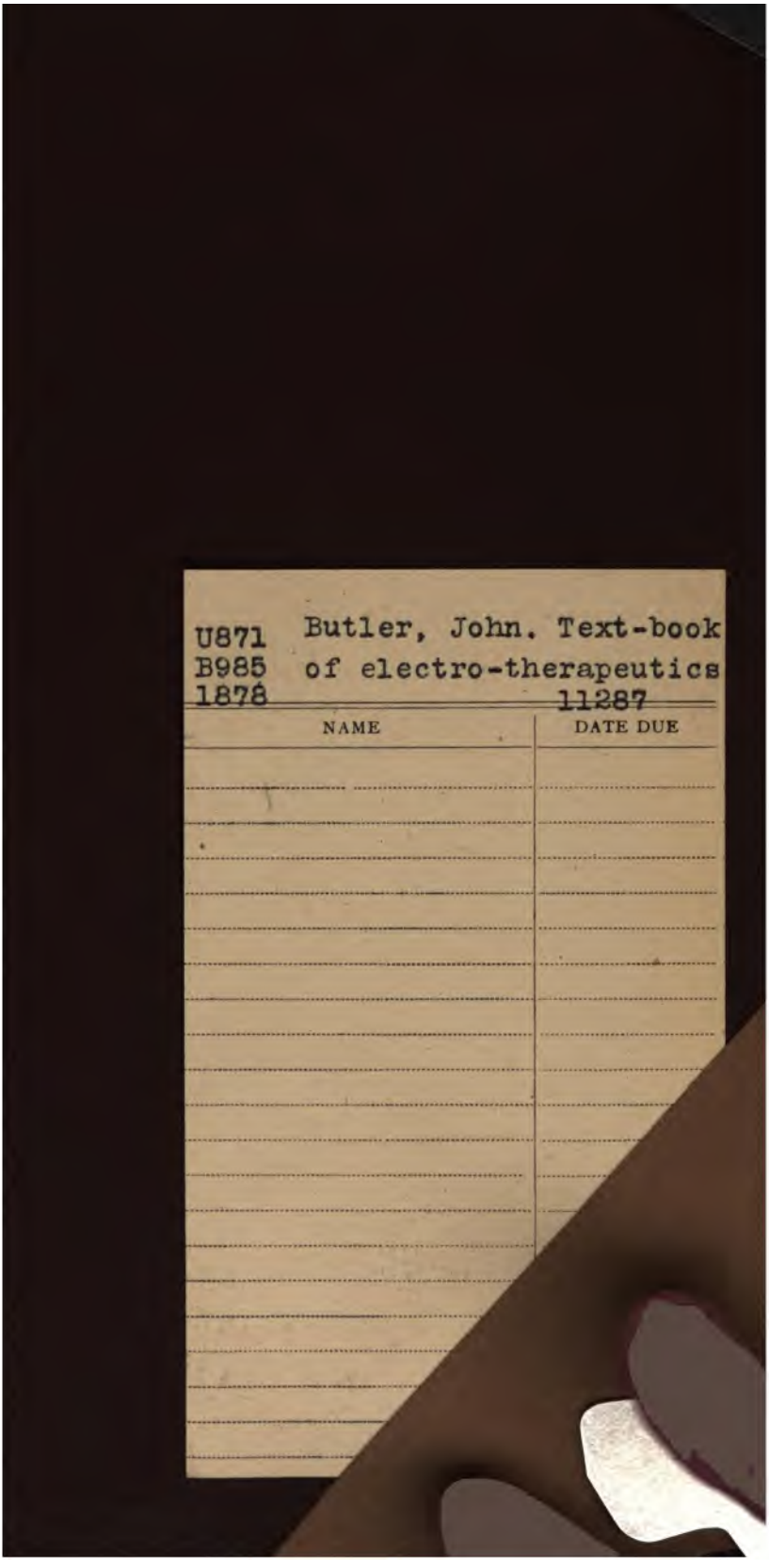
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